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Contents.

	PAGE
Test Bars for Cast Iron	189
A Practical Cost System for the Small and Medium-Sized Foundry	190
A Planing-Machine Knife Grinder	193
Institution of British Foundrymen	194
Stainless Steel	195
Treatise on Foundry Practice	195
Methods of Cupola Blowing Compared	196
Fifty Years of Foundry Work	197
An Apprenticeship Course in Foundry Practice.—XXXIII.	198
Surface and Internal Defects in Iron Castings	200
Correspondence	202
Moulding a 3-in. Grooved Pulley from a 2-in. Grooved Pattern	204
Iron and Steel Markets	205

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institution of British Foundrymen.

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Test Bars for Cast Iron.

The Institution of British Foundrymen some time ago appointed a Committee to study the question of the issue of a suitable specification for the testing of cast iron, to present this for consideration by the British Engineering Standards Association, and to co-operate with the Association Technique de Fonderie and the American Society for Testing Materials. This committee has had several meetings under the chairmanship of Mr. J. Shaw, of Sheffield, and has reached the stage of issuing a tentative specification. This is having the attention of foundrymen all over Great Britain, but we fear that in a large number of cases the policy of leaving it to the "other fellow" is being adopted. When the specification has to be worked to by all foundrymen, these are the very people who will be the first to say, "whoever invented these ought to be boiled," or something even stronger. It is for this reason that we wish to impress on all foundrymen that if they have any definite and constructive views they should place them before the committee, through a member of the Institution, immediately, otherwise it may be too late. Whilst it is beyond our province at the moment to discuss technically and publically the tentative specification, we would point out for the consideration of foundrymen that the following queries arise:—(1) Should bars be cast on the casting? In this connection it should be borne in mind that they may become annealed, at least, at one end. (2) Can one test-piece cast separate under definite standard conditions represent the casting as a whole? The major portion of British opinion on this question is that such a bar represents only those sections which roughly approximate the section of the bar. (3) Will three bars cover the major portion of the field? This is a problem which requires much consideration. Obviously, three cannot, but then the number of sizes of bars must be kept within a reasonable limit. General opinion seems to favour this. (4) Should chemical analyses be specified? If we ventured any opinion at all, we should certainly limit it to a maximum of one, but for the majority of work the time is not yet ripe for the laying down of any hard and fast rules as to chemical analysis. This is not meant to convey that steelworks should not specify that hematite has to be used for the manufacture of ingot moulds. (5) Should the tensile strength be specified? Metallurgically speaking, cast iron being practically inelastic, no works testing machine is capable of returning really accurate results. It is a delicate operation and anything in the nature of unevenness in any direction can materially influence the result. (6) Should the Fremont test be considered? This is an extremely important aspect, as it relates to quite small test-pieces which can often be taken from the actual casting without causing material damage. From a mathematical point of view, the multiplication to make the test bear reference to large sections increases any original error to a corresponding extent. It is revolutionary, but should not be turned down without receiving the closest consideration. (7) Is sound testing practical? We confess that up to the time of writing we know very little of this test, but more information is to be given by Mons. Ronceray at the next meeting of the London Branch of the Institution (March 9). We are afraid, however, that even if foundrymen did recommend either of these last two methods, the engineers on their side would require much convincing. After all, the average engineer mentally translates any test to tensile strength per square inch, and too often assumes that this is twice the elastic limit. In conclusion, we would again remind foundrymen to express their views now and not wait until a test has been decided for them. Grumblers will at least have the satisfaction of knowing that an immense amount of work has been done by foundrymen for foundrymen in finding a solution to a very difficult question.

IT HAS BEEN decided by the council of the Institution of Mechanical Engineers to hold the next summer meeting of the institution in Glasgow in the last week in June. The proceedings will begin with the reception of the president, council, and members of the institution by the Lord Provost, Sir Thomas Paxton, and during the week a civic reception will be given in the City Chambers on the invitation of the Lord Provost, Magistrates, and Town Council.

A Practical Cost System for the Small or Medium-Sized Foundry.*

By Peter I. Hill, F.C.W.A.

The system of costing is based on practical experience of foundry conditions.

It is a system that not only supplies all that is necessary in the way of cost data, but in addition it furnishes a fund of other information most valuable to the management, enabling the standardisation of method and reduction of cost to be effected without impaired efficiency.

Subsidiary to the system, other accounts are operated to show the progressive position of the company, so that it is possible to determine at short intervals what progress is being made towards the financial trading results without having to wait until the end of the trading period.

The system is one which can be operated as part of the financial system of accounting, or it can be run independently, but in the latter case it is essential that some form of reconciliation with the financial books of account should exist to ensure that all items of expense are recorded and taken care of.

A Plea for a Standard System.

As drafted, the system is specially suited to the needs of the small or medium-sized foundry where only a limited accounting staff is available; it is, however, a system that lends itself to development and can be adapted to suit the requirements of foundries of any size. After all, we have much the same elements to contend with no matter what the size of the foundry, but in the larger foundries greater division of expense into departments, grades of castings, etc., is highly desirable, and can be obtained. Further, the system is one which can be operated in a works of which the foundry only forms a part.

It is not the object of the subject to emphasise the necessity for costing in foundries, which is an admitted fact, but the author, however, would like to put forward a plea for standardisation of method. The Belgian Foundrymen's Association have had a Committee on investigation dealing with the matter, and their report was issued a few months ago as reported in THE FOUNDRY TRADE JOURNAL issue of November 30 last. Through the courtesy of the Editor, the author has had an opportunity of perusing the report of the Belgian Association, and in many respects the system outlined corresponds with the one it is proposed to deal with. There are, of course, several debatable points raised which form material for valuable discussion. Doubtless, in this matter, we, in this country, will not fall behind our Belgian friends, and it is to be hoped that something of the kind will be attempted in England, as undoubtedly a uniform system of costing would be to the well-being of the trade.

It is proposed to treat the Paper in three stages, which are:—(1) To explain the system generally by the aid of the chart: (2) to explain the application of the system and its operation in the foundry; (3) to point out the uses of the system for the purpose of managerial control of expense and also of selling.

Being intended as an appeal to practical men, it is not proposed to deal extensively with the details of the accounting side of the system, but more particularly to explain what it is possible for the accountant to do, given the practical man's assistance. After all, the practical and the accounting sides of the system are two separate functions, each being essential, and for the attaining of results, co-operation is necessary. Further, it is proposed to treat the subject somewhat on elementary lines for the benefit of those to whom costing may be in the nature of something new.

Part I.—Outline of System.

On referring to the chart (Fig. 1) it will be observed that there are the usual elements of expense which are first of all divided under three main heads, which are:—(1) Material. (2) Labour. (3) Establishment and General charges, and all items of expenditure can without difficulty be brought under one of these.

The next step is to dissect these elements into two groups, material and labour coming under the headings of *direct or indirect* expenses, and establishment and general charges being wholly *indirect*.

Materials.

Direct.—These are the materials which form the cupola charge, and as such can be traced *directly* to the finished casting. They comprise pig-iron, scrap iron, coke and limestone or other flux.

Indirect.—These are the materials which whilst they are equally necessary to production do not form part of the direct cupola charge and are divided into two groups, viz.:—

Group (a).—This includes those materials which go directly into the foundry, and which are consumed in the process of manufacture, such as moulding sand, coal dust, core gum and oil, coal and coke for drying ovens, etc.; manufacturing and other sundries including chaplets, studs, sprigs, blacking, resin, plumbago, wires for cores, etc.; electricity, gas and water, sundry inwards carriage items.

Group (b).—This includes those materials which have a depreciable life and consequently are not wholly consumed during the week or month in which they are issued to the foundry, such as small tools, *i.e.*, riddles, sieves, brushes, bellows, shovels, buckets, files, etc.; materials for repair and replacement of fixed and loose plant and buildings, *i.e.*, ladles and shanks, vices, weighing machines, moulding boxes and fittings, bricks and ganister for cupola, spare parts for hoists, runways and other lifting gear, etc.; pattern materials.

Labour.

The division of labour is on similar lines to that of material.

Direct.—Group (a).—This represents the cupola labour and includes not only the men actually engaged on the cupola itself, but all other labour necessary from receipt of the materials to be handled up to the point of tapping out of the cupola, *i.e.*, unloading and stacking of iron, breaking up, conveying to cupola and hoisting on to stage, weighing, charging and tapping out.

Group (b).—Is the labour of moulding and core-making only.

Indirect.—Group (a).—This includes all labour of an indirect character necessary to the operating of the foundry, such as sand milling and mixing, metal carriers, iron dressers, inspection of finished castings, storekeepers, foremen, works clerks, time-keepers, warehousemen, etc.

Group (b).—This includes all labour engaged on the work of repair and maintenance of plant, such as pattern-makers, moulders and filers, general fitters, moulding-box fitters, plumbers, etc.

Establishment and General Charges.

Under the heading of establishment and general charges is included those expenses and standing charges over which the works have no direct control, such as rents, rates, taxes, schedule "A" tax, employers' liability and other insurances, office stationery and supplies, auditing fees, advertising, salaries of the management and administrative staffs generally.

Compilation of Cost.

Having thus completed the analysis of the elements of cost, there remains now to bring these together in such a way as to give the details of cost of production, which is accomplished thus:—

Prime Cost.—This is an amalgamation of the direct materials and labour: "A" (Fig. 1) is the cost of iron at cupola spout and comprising the direct material as charged into the cupola and (*a*) cupola labour. "B" (Fig. 1) is the direct labour of moulding and core-making.

*A Lecture delivered before the Lancashire Branch of the Institution of British Foundrymen, Mr. John Haigh in the Chair.

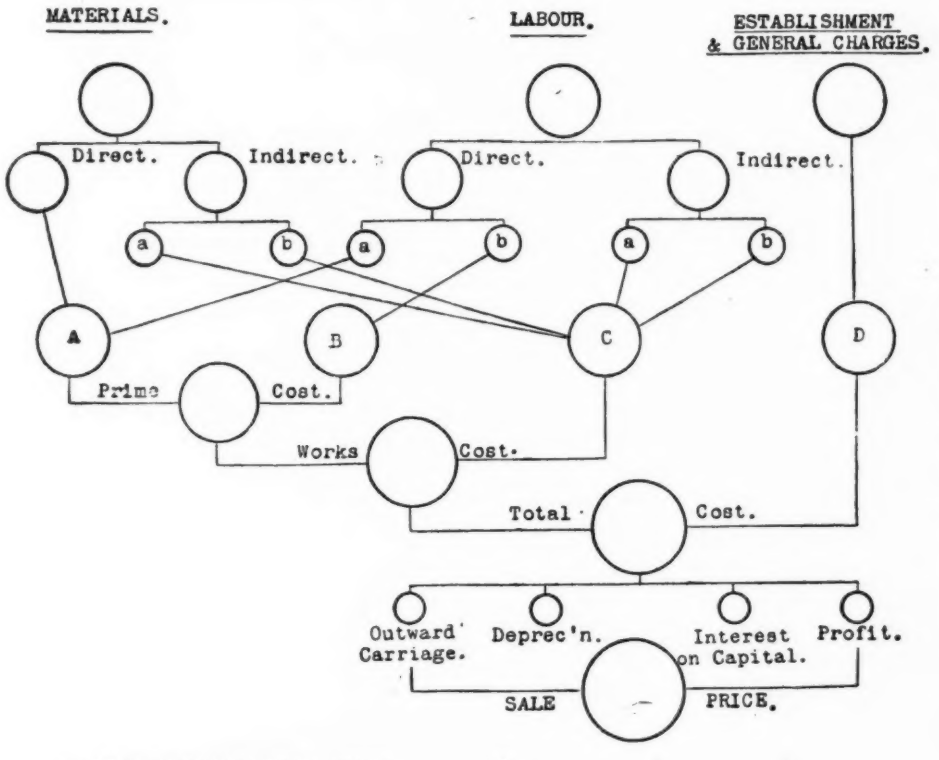
Works Cost.—The works cost is next arrived at by taking the prime cost obtained and adding thereto those indirect factory expenses, both materials and labour, as indicated in Fig. 1 and lettered "C."

Total Cost.—The addition of the works cost and the establishment and general charges give the total cost at works. Up to this point, excluding the item of outward carriage, the cost accounts are in complete agreement with the actual trading accounts.

pre-determined and is only allowed on the value of the plant as at the commencement of the trading period. In the system described, it is dealt with as a supplementary charge; in foundries depreciation bears a more direct relationship to tonnage handled than to labour, and consequently is distributed at a rate per ton estimated on an assumed output for a forward trading period.

The distribution of depreciation in this way is consistent with other conditions, as obviously, if the assumed tonnage is not reached, the machinery

ELEMENTS OF COST IN FOUNDRIES.



A. COST OF IRON AT CUPOLA SPOUT: Direct Materials *and* (*a*) Cupola Labour.	} Prime Cost.	}	
B. DIRECT LABOUR: (*b*) Moulding and Coremaking.			
C. INDIRECT FACTORY EXPENSES, including: Materials. (*a*) Sand, Coal Dust, Core Gum, Fuel, Manufacturing and other Sundries, Electricity, Gas, Water, etc. (*b*) Patterns, Boxes, Small Tools and Replacements of Plant. Labour. (*a*) Sand Milling and Mixing, Engine Drivers, Dressing and Inspection, Works Clerks, Storekeepers, Warehousemen, etc. (*b*) Pattern Makers, Pattern Moulders and Filers, General Fitters and others on Maintenance of Plant, Buildings, etc.	} Works Cost.	}	TOTAL COST
D. ESTABLISHMENT AND GENERAL CHARGES: Rents, Rates and Taxes, Office Stationery and Expenses, Employer's Liability and other Insurances, Advertising, Salaries of Management and Administrative Staffs, etc.		}	
ADD. Outward Carriage, Depreciation, Interest on Capital, Profit			SALE PRICE.

INDIRECT FACTORY EXPENSES, ESTABLISHMENT AND GENERAL CHARGES:
The distribution of these charges is in the Ratio % to the Direct Labour Cost, or in proportion to the Direct Labour Hours.
DEPRECIATION.
Depreciation (although strictly an Item of Cost) is dealt with as a Supplementary Charge additional to the Total Cost at a pre-determined rate per ton.

Sale Price.

The object of the system, apart from the ascertainment of production costs, is to provide a reliable basis for selling and to determine the selling price, there are other items to be added, such as:—

(1) *Outward Carriage.*—This is an expense additional to the cost of production, and varies only in proportion to the cost incurred in delivery of the finished castings; it is therefore added at actual cost.

(2) *Depreciation.*—Strictly speaking, this is an item of cost, and provision must be made to cover; if desired, it can be merged into the cost accounts and distributed on an agreed basis to departments and so on. It is, however, a charge that can be

and plant is not worked to the full extent and the amount written off is proportionately reduced and *vice-versa* if the tonnage as estimated is exceeded.

(3) *Interest on Capital.*—It is at present a debatable point as to whether this should or should not be included as part of the cost of production; if, for example, one pays rent for the premises, this is admittedly interest on capital paid to some other person, and from this point of view alone it seems perfectly reasonable that it should be included. Further provision has to be made in any case to cover for the liability in regard to debenture and other shares which carry a fixed rate of interest. In the present system it is not included as part of the cost, but provision is made in the sale price.

XUM

(4) *Profit.*—This is much the same as interest on capital so far as the sale price is concerned, and it can only be included according to existing conditions at time of sale. As a matter of fact, it may at times be necessary to omit it altogether, as well as some portion of the preceding item of interest on capital invested.

Part II.—Application of the System and its Operation.

Stocktaking.

Commencing with the trading period, there is now a record of stocks on hand, where stored and so on; in theory *all materials*, whether actually in the stores or stored in the open yard, are in stores in charge of the storekeeper to be issued as required in the foundry.

Purchases.

All materials coming in are placed in charge of the storekeeper, a receiving note or invoice being initialled by the storekeeper as an acknowledgment of receipt and responsibility. Establishment and general charges are more a matter for the office to deal with and are referred to later on.

Wages.

A record must be made of all work done by individual workmen, and in the case of direct labour, such as moulding and core-making, full details should be supplied as to the number of pieces made and the order number to which they are to be charged.

In the case of such labour as iron dressing, storekeeping, general labour, etc., it is not, of course, possible in many cases to charge direct to a given order, and it is often sufficient to state the class of work performed by the man, and if transferred from one class of work to another, the time spent on each should be separately stated. The exact method by which this can be achieved will depend to some extent upon the conditions of the foundry, but in all cases of direct labour, *i.e.*, moulding and core-making, the workman should be given his instructions in writing as to the work to be performed, the order or instruction note to contain details of the works order number, etc., for the purpose of charging up to the job.

For *factory repair and maintenance work* a suitable code should be prepared of standing order numbers, and whenever work is done, these numbers should be stated on the time record sheets. Factory repair and maintenance work is often a source of serious leakage, and except in the case of breakdowns or other similarly urgent work, should not be proceeded with until authorised by the manager and a written instruction bearing the code number issued from the manager's office, even in the case of breakdowns, where it is not always possible to get the order immediately, the same routine would be followed afterwards to ensure that the job is placed on record and charged up.

Time Records.

An essential part of any system of costing is an efficient method of time-keeping of jobs, etc.; these can be recorded under the supervision of the foreman, but wherever possible clock records are desirable. A common practice is for the men to make up a weekly time sheet.

Experience proves that this is not a very reliable method, excepting in such cases as labourers and others who are engaged full time on one particular class of work. For men working under order numbers a daily time record sheet, certified by the foreman, will be found far more satisfactory.

Stores Issued.

Stocks on hand and purchases having been dealt with, there is now to deal with the issue of those materials to the foundry, taking the *direct materials* first. A cupola charge sheet is prepared daily, giving details of the various classes of iron, scrap, coke and limestone charged into the cupola, distinction being made as between scrap iron produced in the foundry and that purchased from outside. The same report will also record the weight of scrap returned from the foundry from the previous day's working, *i.e.*, gates, runners and other general scrap, the over-metal being also shown as a separate item.

Other information required, as part of the system for statistical data and for the information of the management, is also included in the daily return, such as time of blast on, the time off, number of hours melting, together with any remarks as to the working of the cupola, breakdowns, poor quality of coke, etc.

The return, when completed, to be signed by the manager and storekeeper before being sent into the office.

Indirect Materials.

Group (a).—The materials coming under this group and which are generally described earlier on, are such as can, generally speaking, be safely left in the care of the storekeeper to issue according to the requirements of the foundry and to make report of all materials issued. Gas, water and electricity consumptions are also included.

Group (b).—The materials coming under this group are principally small tools, materials for repair and replacement of plant, etc., and these should only be issued by the storekeeper on a requisition signed by the manager or other authorised person.

Materials for factory orders enter into this section, and the same order form, as issued by the manager, will cover for both labour and materials, the latter being recorded on the reverse side of the order form.

Production Report.

A production report is also prepared by the inspection department of all castings produced. The report should be as complete as possible as to the number of castings produced, their weights and the respective order numbers to which they refer; this detail will vary according to the requirements of the particular foundry. Included in the report details must be supplied of any castings made for own plant, such as moulding-box parts, patterns and sundry castings for repair work.

Waster Castings.

Waster castings are also included in the production report, and a brief statement made according to circumstances as to the cause of rejection, *i.e.*, bad workmanship, poor quality iron, faint run, etc. An important point in regard to waster castings is that subsequent labour costs are "replacement costs" and chargeable to overhead expense in the majority of cases.

On completion and after being certified by the manager, all these various reports are sent to the office to be dealt with.

Office Routine.

The next function lies with the accounting office and is briefly explained.

Stocks.—Stock records as at the commencement of the trading period are carefully analysed, passed through a journal and posted to the debit of the respective stock accounts to which they refer.

Purchases.—Invoices for materials purchased are similarly treated, being also analysed and posted to the debit of the stock accounts. Establishment and general charges are treated in the same way, being journalised and posted to the debit of the various expense accounts to which they refer.

Wages.—A wages analysis is made up to agree with the gross wages paid before any deduction is made for national insurance, etc. The gross wages are dissected under the various classifications of labour, both direct and indirect, in accordance with the certified time and other records received from the works. The analysis will also include details of the hours worked in the case of direct labour costs. As in the case of purchases, the amounts are next journalised and posted into the ledger to the debit of the various wages expense accounts.

Stores Issued.—The various reports from the works are next dealt with. They are: (1) Cupola charge sheet; (2) storekeeper's stores issued sheet; (3) various dockets for tools, etc.; (4) factory orders. These are priced up, journalised and posted into the ledger to the credit of the respective stock accounts.

Cost Sheet.—All these details being entered up and balanced and the details of castings made, scrap recovered and waster castings having been summarised from the production report, the accountant is now in a position to prepare the

working-cost sheet. The items are transferred direct from the ledger to the cost sheet, the debit being the issues of materials and wages paid during the period, less credit for any materials returned to stores or other allowances. Credit is also allowed for the value of scrap recovered from the foundry, including the over-metal and waster castings. This presents very little difficulty. The matter of distribution of the establishment and general charges, however, calls for special attention. Certain of these charges come through at intervals, as, for example, rates, taxes, schedule "A" tax, fire insurance, employers' liability insurance, etc., and for these it is necessary to allocate a specified amount to each month or other period as under review, the amount so allocated and not the amounts paid during any one month being the figure carried to the cost sheet.

The cost sheet being compiled, it now remains to work out the various percentages and averages, and this requires no explanation.

Sales Account.

As part of the system a sales account is made up giving details of the gross sales, deductions being made for any amounts allowed to customers in the way of returns or other allowances. The amounts paid for outward delivery charges are also deducted. Thus the amount is brought back to a price obtained at works; an average net sale price is worked out for comparison with the cost at works.

Castings Stock Account.

A stock account for castings is also operated to include both for weight and value. This account is debited with stock brought forward and the castings produced and credited with the net sales, castings produced for own plant and the stock left on hand to be carried forward to next period.

The difference as between the debit and credit amounts represents the trading results on the period, subject to depreciation charges, and is carried to a progressive account or summary; the summary also contains details of the total cost as brought down from the cost sheet.

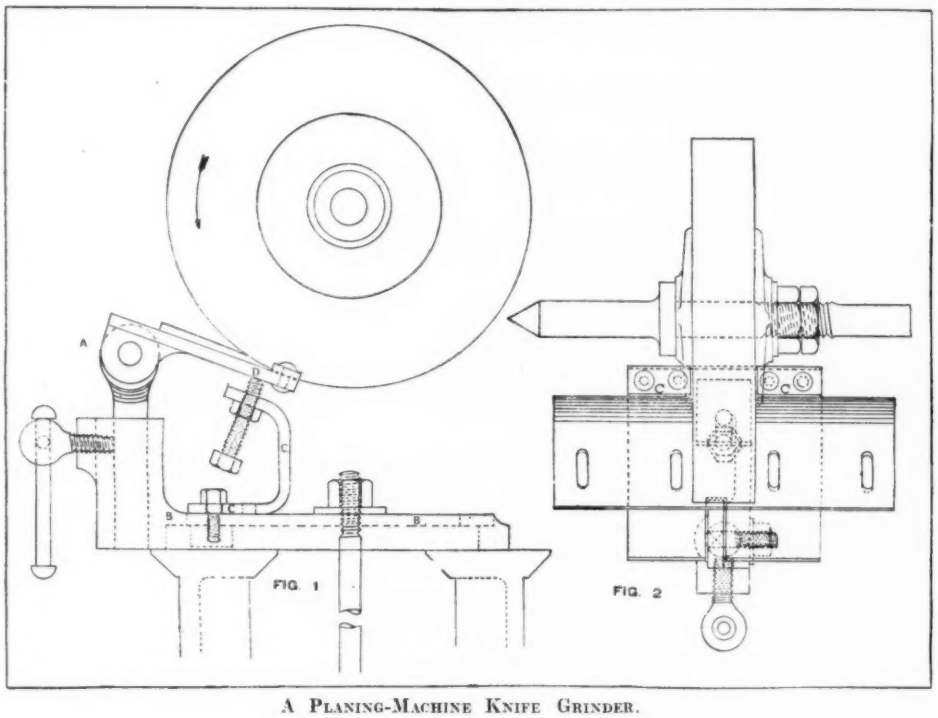
(To be continued.)

The Birmingham Electric Castings, Limited, are being wound up voluntarily. Mr. J. Durie Kerr, Waterloo Street, Birmingham, has been appointed liquidator.

A Planing-Machine Knife Grinder.

By V. Dewhurst.

As additions to pattern-shop equipment become more general, so the need to keep them efficient grows. Planing and trimmer-machine knives are often below standard in efficiency, owing to lack of grinding facilities available. Want of grinding requires extra sharpening or whetting, and even then the knives do not cut so cleanly as when well ground, though with indifferent sharpening. Many accidents to fingers in pattern shops are due to dull tools. Where there are included in the equipment, say, two surfaces, one thicknessing-planer and four to six trimmers, large and small, the grinding of the knives for them becomes a matter of importance. The usual practice is to send them to outside firms who specialise in this work. This is often an inconvenience, unless at least three sets are in use.



A Planing-Machine Knife Grinder.

The writer some little time ago decided that the repeated stoppage of the machines, owing to knives being away for grinding, should, at least in his shop, cease. He therefore arranged the following method for grinding these knives in the lathe.

The result has been so successful that it is intended to fix the apparatus up permanently on a short gantry. It will thus be ready for immediate use, as well as serving for grinding hand-plane blades, chisels and the like. The "stone"—a carborundum wheel—is mounted on a spindle to run in hollow centres between the two headstocks in the lathe, Fig. 2, driven by catch plate and dog as in turning-shop practice. The rest, to carry the blades, having a hinged joint as at A, Fig. 1, is held in the usual wood-turning rest-bracket B, Fig. 1, and fixed to allow the blade to move sideways from end to end underneath the "stone," whilst revolving towards the operator; the cutting edge of the blade being pressed against the guides C C, Fig. 2, on both sides of the wheel. A piece of spring steel of suitable width formed to shape as at C, Fig. 1, makes an adjustment for feed and secures the position for the hinged joint at A, Fig. 1. Cooling whilst grinding was obtained by using an ordinary turner's drip-can and a piece of sacking arranged to prevent splashing. Very little water is required to keep blade cool. The trimming-machine blades are ground in exactly the same way. A small quantity of thin oil spread on the rest plate at D D materially assisted the blades to slide.

Institution of British Foundrymen.

NEWCASTLE BRANCH.

On February 17, a Junior Section of the Institution of British Foundrymen was inaugurated in Newcastle, being the first of its kind in this country. The chair was taken by Mr. H. F. Clements.

Mr. Clements, in asking the Branch-President (Mr. H. J. Young) to address the meeting, said Mr. Young had always done a great deal for the foundry trade, and since the idea of having a Junior Section was first mooted, he (Mr. Young) had given invaluable help.

The Inaugural Address.

Mr. Young said one trouble with a Junior Section, he thought, was that it was composed entirely of young men, and consequently lacked experience, and, although youth always held the best cards, age often took the most tricks. The older one gets, the more experience one obtains of working things to the best advantage. He hoped the Junior Section would ever remember to consult people older than themselves, not necessarily agreeing with them, but always listening to them with respect and remembering that they have lived a few more years, and therefore seen a few more things than the Juniors themselves have.

He believed that about 40 firms had been advised of the formation of the Junior Section, and a substantial increase in the attendances was to be expected within a short time. The number present that night, however, was exceedingly good for a commencement, and he congratulated all present on their patriotism in attending the meeting. A project of this kind could only be successful if the members had sufficient pluck and enthusiasm to induce their friends to join. Some boys, however, were sensitive and afraid of being laughed at. A short time ago he advised a foundry apprentice to try to get together a few fellow apprentices and all try to learn and progress generally. The reply was, that the other fellows would laugh at him, but he (Mr. Young) told him to laugh louder; the ultimate result was the gathering that night.

In his opinion, the possibilities of the Junior Section were enormous. If the members were plucky, patriotic and enthusiastic, they would change the future of the foundry trade in this country. Juniors to-day are seniors to-morrow, and the young men of the Junior Section will be the Institution of British Foundrymen of the future. He had travelled about a good deal, and knew that other Branches were watching this movement very closely and wondering whether it was going to succeed. The Junior Section was to be managed by juniors, and would not be interfered with by the Senior Branch. It was to have its own Presidents, secretary and Council, but he would still recommend them to take advice from the older men at times.

They should be intensely proud of their section, and manage it and run it on such lines that every decent lad in the district will want to be a member. They should make it so that a decent lad could not afford *not* to be a member. If they bettered themselves and their trade, then better wages and better treatment would unfailingly be the result. They should strive for some status of efficiency. He thought their efforts should be directed towards holding examinations once or twice every year at centres all over the country—not high-flown scholastic affairs, but examinations in efficiency of work and knowledge about that work. Everybody getting over a certain percentage of marks should receive a certificate or "ticket," and those tickets would become objectives for every boy and man to work for. It would alter history, and if the Institution of British Foundrymen possessed that enthusiasm and initiative which he believed it possessed, there would not be long to wait. Let the Junior Section get strong and healthy, and continually demand these certificates until they get them—but the certificates would be utterly valueless unless they indicated a strict standard of efficiency. Once there is an "easy" certificate available, it would put the Institution back fifty years.

The Junior Section ought not to be a kill-joy affair. They could form cricket clubs, football clubs, and have social gatherings and lively meetings. Why not a club in Newcastle? It could be done later on, and merely depended upon membership.

All this meant, no doubt, a lot of hard work, but, considering that the average man *has* to work the whole of his life, no matter whether he likes it or not, he might just as well decide to like it and to make it interesting. As a matter of fact, as they got older, they would find it about the only thing that could be always interesting.

He proposed that each of them should make a resolve to bring in five new members before the end of the session; let them fill themselves with pluck and enthusiasm, and their influence would spread like wildfire.

Those people who had done the work up to now should be rewarded by being appointed to the first important positions. This Junior Section would ultimately be representative of the whole of Tyneside and district, but at the beginning that was impossible. In the future, however, they should aim at having a member of council in every large foundry in the district; indeed, every foundry should have at least one Junior Section member pledged to work for it and get it respected. Call them delegates or members of council—anything they liked—but enroll them.

The Junior Section had the good wishes, the influence and the wealth of the Institution of British Foundrymen behind it. He knew that immediately after his address the Chairman was going to ask them if they were willing to become members of the section. He asked for a solid vote. He asked that Tyneside should stand as an example to the whole country. Let nobody spoil the value of an unanimous decision.

When asked by the Chairman if they were willing to become members and support the section, everyone in the room eagerly responded.

The Chairman then explained that there were to be two classes of membership. Class A was for members over 18 and under 26 years of age, the annual subscription being 10s. 6d. The payment of this subscription also made the person into an Associate of the Institution of British Foundrymen. Class B is a special membership of the Junior Section, only open to those under 18 years of age, the subscription being 5s. 6d.

Election of Officers.

Mr. Jay, in proposing a President for the Junior Section, said he would like to point out that they should have an extremely enthusiastic person for their first President, and he should certainly propose the Chairman (Mr. Clements) to fill that office, because he was the originator of the Junior Section. The proposal was seconded by Mr. Little.

Mr. H. C. Jay was nominated as Senior Vice-President, Mr. S. D. Blenkinsop as Junior Vice-President, and Mr. J. E. O. Little as secretary of the Junior Section.

Messrs. E. J. Rang, Gospel, J. Bell and Chapman were appointed members of the Council to represent Class A, and Messrs. Bowden, Mitchel and Shields to represent Class B. It was decided to leave the remaining vacancies on the Council until the next meeting.

The President (Mr. Clements) said that year by year the foundry trade had gained more and more knowledge in the making of castings and foundry work in general, and, although it possessed a large amount of information, yet other trades were in advance. At the present day the foundryman is unfortunately in the position of being looked down upon, because his trade has been rather neglected, and, although it is one of the most exacting trades, the foundryman's name does not appear to be so important as that of the electrician, for example. The Junior Section would strive to raise the status of the foundry trade, and if as many as possible support it, there was a chance of this being accomplished.

XUM

He said that, only 18 years ago, about six men had met together with the purpose of improving the foundry trade socially and technically. At that meeting the Institution of British Foundrymen was formed, and that Association has now about eighteen hundred members. He thought it was quite possible that the Junior Section might similarly develop.

They proposed to have works visits, social functions, and interesting talks and discussions on every phase of work connected with the foundry trade. A great deal of knowledge could be gained by these means, and the ones who are most enthusiastic are sure to obtain the best jobs. Notices of the meetings will be sent round to the members, and, by bringing their troubles for discussion, they would be able to learn something and make progress. The President then proposed a vote of thanks to Mr. Young for attending.

MR. YOUNG, in acknowledging the vote of thanks, said that he was amply rewarded for coming by the fact that they were such an enthusiastic gathering. The juniors would learn to bring forward their ideas, and to discuss matters without losing their tempers. Some of them, he hoped, would try to write papers, and then they would realise what a lot of facts they do not know and have to look up—points they thought they *did* know. The formation of a Junior Section had been talked about by some of the most influential men in the district, and it was quite evident that many people were interested in what was happening that night.

Stainless Steel.*

By J. H. G. MONYPENNY.

The general properties of stainless steel and also its resistance to corrosion are influenced to a considerable extent by the heat-treatment which the steel has undergone; and in order to form a basis for the discussion of these variations, the lecturer first gave a brief account of the structural changes produced in stainless steel by different forms of heat-treatment. The influence of varying composition, more particularly of carbon content, was next dealt with, and it was emphasised that there were available a whole range of steels, all possessing the property of resistance to corrosion but differing from each other as mild steel does from file steel. Passing next to the mechanical properties, a general account of these was given and curves illustrating the tests obtained from steels of varying composition were shown. After a short account of the behaviour of the steel at high temperatures, the general question of corrosion was dealt with and the influence of varying composition and heat-treatment on the resistance of the material to corrosion, correlating the latter with the difference in structure previously noted, pointed out. It was shown that the material has the greatest resistance when hardened and the least when annealed, and that cold work decreased the non-corrodibility to a considerable extent.

Finally the lecturer gave a short account of some of the purposes to which stainless steel has been applied, dealing more particularly with hydraulic and steam plant. Numerous instances were given where the resistance to corrosion, and also to erosion by rapidly moving liquids or gases, of the steel had effected very considerable economies in working. Among the examples quoted were rams for hydraulic pumps, hydraulic and steam stop valves, steam trap valves, boiler feed check valves, etc. The results of experiments demonstrating the great resistance of the steel to erosion by a high-pressure steam jet were given. The lecture was illustrated by a large number of lantern slides.

LORD BESSBOROUGH, presiding at the annual meeting of the London Electric Supply Corporation, said the company had been successful in securing a contract for fifty years for the supply of the whole of the energy required for the electrification of what was the South-Eastern Railway. The contract would mean an additional output of between 80,000,000 and 100,000,000 units per annum.

* Abstract of a Paper read before the Birmingham Metallurgical Society.

Treatise on Foundry Practice.

We have many times recently been asked for a comprehensive list of works on foundry practice. The following is not complete, and we shall be pleased to receive from readers or publishers details of any which are missing. These will be published later as a supplementary list.

THE PRINCIPLE OF IRON FOUNDING. By Sexton & Primrose.—The Technical Publishing Company, Limited, 55-56, Chancery Lane, W.C.

IRON FOUNDING. By B. Whitley.—Sir Isaac Pitman & Sons, Parker Street, Kingsway, London, W.C.2. 3s.

AMERICAN FOUNDRY PRACTICE. By T. D. West. Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2. $2.50.

GENERAL FOUNDRY PRACTICE. By W. Roxburgh.—Constable & Company, 10, Orange Street, Leicester Square, London, W.C. 10s. 6d.

NOTES ON FOUNDRY PRACTICE. By J. J. Morgan.—Chas. Griffin & Company, Limited, Exeter Street, Strand, London, W.C.2.

IRON FOUNDRY PRACTICE. By G. J. Pitt.—Cassell & Company, Limited, La Belle Sauvage, E.C.4. 6s.

FOUNDRY PRACTICE. By R. H. Palmer.—Chapman & Hall, Limited. 15s. 6d.

FOUNDRY (IRON, STEEL AND BRASS). By F. Foster.—Iliffe & Sons, Limited, 20, Tudor Street, London, E.C.4. 2s.

BRITISH RESOURCES OF REFRACTORY SANDS. By P. Boswell.—Taylor & Francis, Red Lion Court, Fleet Street, London, E.C.4. 8s. 6d.

CAST IRON IN THE LIGHT OF RECENT RESEARCH. By Dr. W. H. Hatfield.—Chas. Griffin & Company, Limited. 12s. 6d.

GENERAL FOUNDRY PRACTICE. By A. McWilliam & P. Longmuir.—Chas. Griffin & Company, Limited. 15s.

PRACTICAL IRON FOUNDING. By J. G. Horner.—Whittaker & Company, 2, White Hart Street, Paternoster Square, London, E.C.

THE ART OF PATTERN-MAKING. By J. Chase.—Chapman & Hall, Limited.

FOUNDRY MACHINERY. By E. Treiber.—Scott, Greenwood & Son, 8, Broadway, Ludgate Hill, E.C. 3s. 6d.

MOULDERS' TEXT-BOOK. By T. D. West.—Chapman & Hall, Limited, 11, Henrietta Street. $2.50.

PATTERN-MAKING. By J. Kelly.—The Machinery Publishing Company, Limited.

FOUNDRY MOULDING MACHINES AND PATTERN EQUIPMENT. By E. S. Carmen.—Penton Publishing Company, 2, Caxton House, S.W.1.

PRODUCTION OF MALLEABLE CASTINGS. By R. Moldenke.—The Penton Publishing Company, 2, Caxton House, S.W.1.

BRASSFOUNDING. By J. Horner.—Emmott & Company, 65, King Street, Manchester.

MODERN IRON-FOUNDRY PRACTICE. By G. R. Bale.—The Technical Publishing Company, Limited, 287, Deansgate, Manchester. 3s. 6d.

FOUNDRYMEN'S HANDBOOK. — Penton Publishing Company, 2, Caxton House, Westminster, S.W.1.

CAST IRON. By W. J. Keep.—Chapman & Hall.

A COMPARISON BETWEEN BRITISH AND AMERICAN FOUNDRY PRACTICE, WITH SPECIAL REFERENCE TO THE USE OF REFRACTORY SANDS. By P. G. H. Boswell.—Hodder & Stoughton, Limited, Warwick Square. 4s. 6d.

AMERICAN MALLEABLE CAST IRON. By H. A. Schwartz.—The Penton Publishing Company, Caxton House, S.W.1. 35s.

PRACTICAL PATTERN-MAKING AND MOULDING. By W. H. Wilson.—John Heywood, 2, Amen Corner, London, E.C.

PARTICULARS OF PART of a large contract for locomotives and rolling stock were made known in Glasgow on February 23. William Beardmore & Company, Limited, are to build 17 engines, and tenders submitted by the North British Locomotive Company, Springburn, have also been accepted. The buyers are railway companies in the East of India, and the locomotives are to be mostly of the large shunting tank type.

Methods of Cupola Blowing Compared.

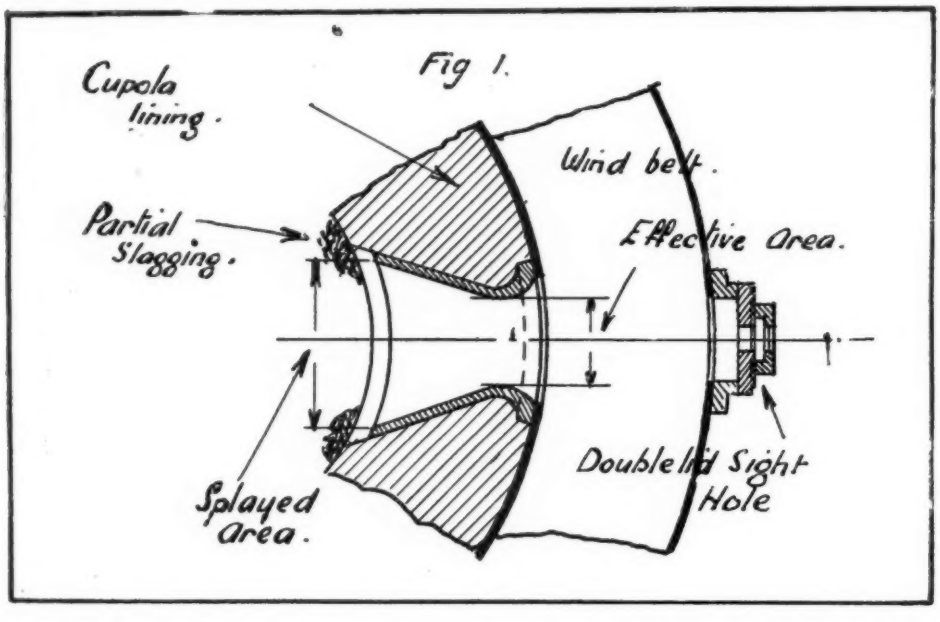
By E. A. Roper.

This article is prompted by the knowledge gained through close association with users of these units, that their difference and relative value are not generally fully understood.

The essential difference between the fan blower and the Roots' blower is that the former induces the air it delivers, whilst in the latter the air gravitates into the blower casing, is enclosed by the rotating drums, and discharged through the outlet. As a definite volume of air is discharged, neglecting slip, for each rotation of the drums, it is known as a positive blower.

If the blast-pipe leading from the fan to the cupola is closed by a regulating valve, the fan is prevented from inducing air and runs light, and the only work done is that the air inside the casing is disturbed and raised to a pressure depending on the speed of the impeller.

The fan is therefore running light when the blast-valve is closed, only about one-third of the normal working power being absorbed, the fan being normally loaded when the area of the opening of the valve, or the subsequent resistance in the cupola, is sufficient to allow the correct volume of air to pass at the pressure for which the fan is designed.



These conditions are reversed with the Roots' type blower, and if the blast-valve is closed the blast would have to be exhausted through a relief valve fitted between this and the blower.

The air being forced out through this relief-valve, which is loaded above the working pressure, more than the normal working power is absorbed, and the blower is running light when the valve is fully open and no subsequent resistance offered to the discharging blast.

Volume and Pressure.

The pressure of blast delivered from a fan depends on the periphery speed of the impeller, and if insufficient resistance is offered a large increase in the volume of air delivered takes place, the fan endeavouring all the time to deliver this at the pressure corresponding to its speed.

This would seriously overload the driving mechanism and upset the correct working of the cupola, the worst running condition for a high-pressure fan being when delivering blast against no resistance. It follows, therefore, that a correct resistance is essential for a fan where a specific volume and pressure of blast is required, as in the foundry cupola.

The Roots' type blower, however, delivers a constant volume of blast under all practical conditions, as the drums revolve at a definite speed and sweep out of the casing a constant number of cub. ft. of air per min., and it is the pressure alone that varies, this change varying directly as the resistance offered to the blast.

Application.

The points emphasised above give the key to the correct installation of either of these units. Obviously, any leakage in the blast mains, or from badly fitting sight-hole castings, etc., on the cupola wind belt, will result in a high power loss with the fan installation, and a loss in the melting capacity, due to a fall in the blast-pressure with the Roots' blower, as this blast escapes to the atmosphere against no resistance.

This also applies to the careless opening of the sight-holes for poking, etc., which may seriously overload a direct motor-driven fan.

To prevent this, sight-hole castings should be fitted with double lids, a small one for poking and a large one for cleaning the belt when the fan is not running.

This power loss does not occur on a Roots' blower installation, as the opening of the sight holes takes the load off the blower, but it more rapidly reduces the pressure of blast supplied to the cupola than with a fan, as the latter absorbs more air to make up the deficiency.

In either case, therefore, the suggestion about sight-holes is equally valuable, and leakage in pipe joints, etc., should not be allowed.

Cupola Design and Resistance.

Whilst a cupola designed for a fan will give equally good results to a Roots' blower, this is not reversible, as some cupolas giving fairly good results with the latter are totally unsuitable for a fan.

A cupola with a low charging hole and numerous small tuyeres, supplied with blast from a Roots' blower, could be arranged to give fairly good results, although it is not the practice the writer recommends because the correct volume would be delivered, and any restriction of the tuyeres due to slagging would raise the pressure which would help to keep them free.

With the blast supplied with a fan, however, the pressure would remain constant at that corresponding to the speed, and less and less blast would be supplied as the restriction increased,

resulting in slower melting and less driving power being absorbed.

The tuyeres in this case would have to be kept free by poking, and the constant variation in volume of blast supplied would lead to very indifferent melting.

Which Unit is the Best for the Purpose?

The answer to this question is whilst the Roots' blower is a safer unit to instal by inexperienced people (particularly on many existing cupolas which have not been re-modelled), the fan is equally as good if the cupola and blast pipes are suitably designed. It is cheaper to instal and repair, equally efficient, and takes less power to drive.

By the cupola being suitably designed is meant chiefly that the resistance necessary to obtain the requisite pressure of blast is obtained in the cupola itself.

This is done by having the charging-hole at the correct height to give the pressure, or resistance, required, making the tuyeres of ample area and splaying these on the inside, so that partial slagging does not interfere with the effective area as shown in Fig. 1.

All unnecessary resistance between the fan and the inside of the cupola, such as sharp bends, long blast-pipes, etc., should be avoided, as these all absorb power which should be available for delivering the blast to the cupola.

It should be noted here that these are also the correct conditions for a Roots' blower installation, but while essential for success with a fan, are not as essential with Roots' blower owing to its positive action as previously explained.

Control.

As it is not usual to make provision for varying the speed of the driving arrangement for the Roots' blower, to control the rate of melting in the cupola the volume of blast supplied is reduced by partly closing the blast-valve in the connecting pipe, and this should be fixed close to the cupola. Part of the blast is then blown out of the relief-valve, or all of it, if it is necessary to stop the cupola suddenly.

Control of the cupola with the blast-valve, therefore, gives no economy in power consumed, when working with a reduced melting capacity in the case as above, as the full amount of blast is still delivered by the blower, and at a higher than normal pressure, as part of it is delivered through the relief valve, which is loaded slightly above the working pressure.

The writer, therefore, suggests an exhaust-valve fixed close to the blast-valve, and between this and the Roots' blower, this being opened to exhaust the surplus blast to the atmosphere as the cupola blast-valve is regulated, or closed similar to the arrangement used on the Tropenas steel converter blast-control valve. This would automatically reduce the load on the blower, when it is required to limit the full volume of blast passing to the cupola.

With the fan installation blast-valve control is all that is required, and a relief-valve is unnecessary, as regulating the valve automatically controls the amount of air that the fan can induce and deliver. In this connection there is still a further point to be raised. At the end of the blow, when the iron and coke are being gradually melted and burnt out of the cupola, the resistance for the blast is also disappearing, which implies that the blast-valve during this period must be gradually closed when working with a fan, or an enormous volume of blast will be blown through at a low pressure, the fan overloading itself in attempting to deliver this at a pressure relative to its speed.

In the Roots' blower installation, as the volume of blast is constant under all conditions, the gradual removal of the resistance in the emptying of the cupola automatically takes the load of the blower and reduces the power consumed, the same volume of blast being delivered at a gradually diminishing pressure and no special attention is necessary.

Unless an automatic blast-valve is fitted with the fan installation the Roots' blower has on this point a distinct advantage, as the regulation of the valve is left to the cupola man, who is apt to be careless unless he has a meter before him showing the power consumed or the driving belts begin to slip.

The only other indication of the increased blast blown through is a large pyrotechnic display at the top of the cupola, which is also an added nuisance, as the sparks are filling up the gutters and depositing on the surrounding roofs, or rapidly burning out the spark arrester.

Efficiency and Cost.

As more power is required for rotating the heavy internal drums and gearing of the Roots' blower than for the light steel impeller of the fan with the driving spindle mounted on ball bearings, the ratio of the work got out to the work put in is greater with the fan than the blower.

This percentage is highest when comparing small fans with small Roots' blowers, as the ratio of the weight of rotating drums to the volume of air delivered diminishes as the size of the Roots' blower increases.

A curve illustrating this proportion would gradually fall as the size of the blower increased, the small fan, therefore, has a greater advantage than the large fan when compared with the Roots' blower on this point.

The cost of high-pressure fans for this work are, of course, considerably cheaper than Roots' blowers, which accounts largely for their growing popularity, in spite of the fact that in some cases they have been improperly installed, and have therefore not proved very satisfactory.

The repairs on fans are also cheaply and quickly performed, and it is possible to carry spare parts, or to have two fans attached to the blast main, one acting as a spare without seriously inflating the installation cost of the plant.

It might be concluded that for continuous melting with long daily runs, that the Roots' blower, being a slower-running machine, would be more reliable, but to meet this condition a large-diameter narrow-pattern fan running at a moderate speed can be used, which would be equally serviceable.

The writer holds no brief for either of these units, and has endeavoured in this article to state the advantages and disadvantages for each from considerable experience and close study of foundry melting equipment.

Fifty Years of Foundry Work.

The many friends of Mr. David McLain will be pleased to learn that with February, 1923, came the completion of fifty years' service of that gentleman to the foundry industry. Though born in Ulster of Irish and Scotch parents, he had never visited this country until last year. He was one of the pioneers of the crucible steel trade of America. Later, though originally a moulder, he worked through the Bessemer and Siemens process. He finally developed a large consulting practice, but being unable to reach as many clients as desired his services, he developed a correspondence course for teaching foundry work, which now has a world-wide reputation as McLain's System, Incorporated.

THE HEPBURN CONVEYOR COMPANY, LIMITED, Rosa Works, Wakefield, have opened an office in South Wales, at Prudential Chambers, Castle Street, Swansea.

SEVERAL IMPORTANT orders for switchgear, etc., have just been secured by Reyrolle & Company, Limited, Hebburn-on-Tyne, which gives the firm a prospect of keeping their factories and employés busy for some time. From New Zealand the company have booked an order for switchgear for Khandallah, to the instructions of the Public Works Department, for part of the electrification known as the Mangahao Electric Power scheme; also an order for plant for the new power station at Evans Bay, to meet the requirements of the Wellington City Corporation, and for apparatus at the Monowai Power Station for the Southlands Power Board. In addition they have received power station switchboard contracts for several of the London Power Supply undertakings, and conversion and extension contracts for existing power stations on Corporation electric supply undertakings in Scotland.

XUM

An Apprenticeship Course in Foundry Practice.—XXXIII.

By Ben Shaw and James Edgar.

LOAM MOULDING.

Part V.

Horizontal Sweeping.

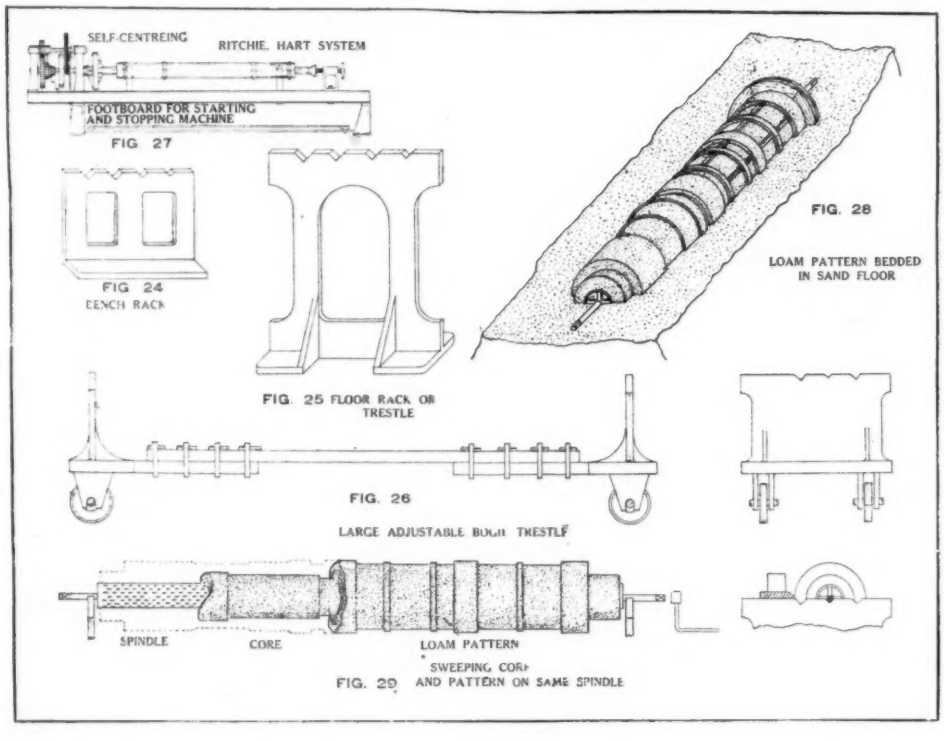
Although a large proportion of cylindrical work in loam is prepared about a vertical spindle when the diameter of the work is small, compared to its length, it is either impossible, extremely difficult, or very inconvenient to make use of vertical sweeping. In such cases the work is swept horizontally. This method of sweeping is rarely employed for preparing a cope or mould direct, because of the necessity of special equipment for the different sizes of work required to be made and also because the mould would need to be jointed on the longitudinal centre which would necessitate the halves being made separately.

The more common method, and one which is economical as well as providing a means for dealing expeditiously with such work, is to prepare a loam pattern from which a mould is made in green or dry sand. While horizontal sweeping in loam has undoubtedly considerable value in the preparation of loam-patterns, there is greater need for this method in the preparation of cores.

For sweeping moulds horizontally the profiled edged board would need to be secured to the spindle in a somewhat similar manner to that for vertical sweeping, the spindle or shaft revolving in bearings and having collars fixed on to prevent side motion. But this is an exception from the general practice. To sweep work horizontally implies that the board is fixed and the spindle rotates, carrying the loam and having its shape defined when passing the board. Invariably the spindle or drum on which the loam is swept is rotated by hand, but when much work of this character is done it is economical to use mechanical power for the purpose. In the main, however, the tackle necessary does not vary whether hand labour or a machine operates the spindle, although it differs considerably from that involved in vertical sweeping.

Tackle Used for Horizontal Sweeping.

This form of sweeping necessitates the use of racks or trestles to support the spindle and possessing bearings in which it can revolve. The design of these racks varies according to the size of work to be done on them. Thus, bench racks are suitable for small diameter work when the swept work can be lifted by hand and transferred to the drying oven. These usually take the form shown in Fig. 24, and are represented by vertical plates having bottom flanges by which they can be fastened to a bench. The vertical plates may or may not be lightened, but along the top edge they have either semi-circular or right-angled recesses to act as bearings for the spindle. These recesses are usually angled, as shown in sketch, and each corresponding pair of racks are made with varying sized bearings to accommodate different spindles.



For larger work that is capable of being carried to a drying oven by hand, floor racks, such as are shown in Fig. 25, are used. The design may, of course, vary, but the principle is the same. These larger racks give better facilities for rotating heavier work. When the work to be swept is very large, then special racks mounted on wheels are more suitable, as they enable the work to be conveyed to and from the stove without lifting. There are various forms of these racks, but as a rule they are prepared in such form that they can be readily adjusted to take work of varying lengths. A suitable design for this type of rack or trestle is shown in Fig. 26.

The most important part of the tackle required for horizontal sweeping is the spindle upon which the work is carried. When the work is small and it is to be removed from the spindle after it has been dried, then a straight piece of round iron cranked at one end to form a handle will suffice. The diameter of this spindle may be $\frac{3}{4}$ in., 1 in., or even $1\frac{1}{4}$ in., but it should be straight between the bearings and not likely to bend under the weight it is required to carry. Apart from small diameter work, however, which can be rodded during the

time of sweeping to give all the strength the work requires, the spindle is used to reinforce the work after it has been dried, as well as to supply the means of carrying the swept work. The form of spindle or drum does not matter much when a loam pattern is to be swept on it, providing it is straight and has the requisite strength to resist bending, but when cores are swept in this way a hollow spindle is used to facilitate venting. The periphery is perforated so that gases from the core have easy access to the inside of the spindle from which to escape at the ends.

These hollow spindles or drums are usually made of wrought iron of about $\frac{1}{8}$ in. to $\frac{1}{4}$ in. thickness, and the perforations are generally rectangular in shape. Sometimes these drums run directly in the bearings on the racks, but it is better practice to secure shafting at each end to serve as journals, and at one or both ends, according to the size of the work to be swept, these journals should be squared off to receive handles, unless, of course, the drum is to be rotated by mechanical power. A machine for rotating work of this kind is illustrated in Fig. 27.

This machine is made by Messrs. Ritchie, Hart & Company, Limited. It is capable of being adjusted to deal with work up to 13 ft. long and $1\frac{1}{2}$ in. to 16 in. dia. Machines capable of dealing with larger work can, of course, be built on the same principle. It will be noted that the speed can be varied to suit the diameter of the work to be swept. This is undoubtedly an improvement on hand labour and it enables the loam moulder to prepare large work single-handed.

Preparing Loam Work on Horizontal Spindles.

The method of carrying the loam on the spindle is similar, whether the work is to be used as a pattern or as a core, or whether the work is removed from the spindle or not, but slight modifications must be made to suit these different requirements. Straw or wood rope is used to form the main body of the work, or when the diameter of the finished work does not admit of either of these being used, hemp may be worked on the spindle. If the spindle is to be removed as for small cores, then straw rope is fed on to the rotating spindle before any loam is applied. This method enables the spindle to be withdrawn easily after the work has been dried, because the straw rope in contact with it is more or less burnt. On the other hand, if the spindle is to remain in the work, loam is applied while the straw rope is being wound about it in order that it will be secure when dried. In such cases the straw rope not only forms a body for carrying the loam, but it serves to connect the perforations in the spindle and opens the texture of the main body of the work for free venting when it is to be used as a core.

A combination of loam and straw rope is worked on the spindle until the contour formed corresponds somewhat with the sweeping board resting on the back of the trestles and fixed at a definite distance from the centre of the spindle, but of smaller diameter. The thickness of the finishing coat of loam varies according to whether a core or pattern is being formed. For the former a coating of loam from $\frac{3}{4}$ in. to 1 in. in thickness should cover the straw rope, especially for large work, and however well it may be wiped on to obtain a good hold, the loam is liable to sag and fall off the revolving work: thus, in practice, it is found profitable to apply a finishing coat of loam as a subsequent operation, and after the main body has been either wholly or partially dried. When this method is adopted the first coating of loam is very thin, merely covering the straw rope, and the surface is usually roughed so that the final application of loam will have a better hold. When the swept work is required as a pattern it can be completed at one operation, as a good body of loam on the outside is not essential, only sufficient to obtain a regular contour being required.

The work involved in the making of cores by horizontal sweeping requires more care than in making patterns, although accuracy is equally essential in both. Small diameter cores need not necessarily have a second coating of loam, providing a sufficient thickness can be successfully carried at the first operation.

Horizontally Swept Loam Patterns.

Much that has been previously stated with reference to the making of a loam pattern by means of a board, fixed to a vertical spindle, is applicable to this form of pattern. It is suitable for cylindrical work, the diameter of which is small compared to its length. It is generally assumed that this type of pattern is only suitable for a one-off job, as in the case of a vertically swept pattern, but this assumption is erroneous because such a pattern may be used many times with reasonable care particularly if it is coated with tar and thoroughly dried. It is, of course, only the main body of the pattern that is prepared in this way, projecting parts which would be weak in loam, such as flanges and other subsidiary parts, such as ribs, facings, bosses, etc., are prepared in wood and attached to the loam body.

This type of pattern is suitable for hydraulic cylinders, stern tubes, etc., that are fairly large and for which the preparation of a wood pattern would be unnecessarily expensive unless many castings are required. In some instances the moulds from these patterns may be made in loam, but as a rule they are prepared in the sand floor, half of which being bedded in, as shown in Fig. 28. Hydraulic cylinders are usually an exception to this rule, these being made in boxes to enable them to be cast vertically. When the work is to be used as a pattern the spindle or drum remains in it, which not only adds to the strength of the loam body, but gives facilities for withdrawing it from the mould.

Cores Swept Horizontally.

This method is more frequently adopted for cores than patterns, because even though many castings are required and a pattern is supplied, the cores can be more effectively and more economically made on a horizontal spindle. Thus for pipes, columns, long bushes and other cylindrical work of a similar character, core boxes are rarely supplied unless branches or some other connections necessitate some kind of skeleton form of core frame to give the requisite shape. When the cylindrical casting is required to have lightening holes through the metal, such as for certain forms of columns, the cores that cut through can be made on the main cylindrical core.

This method is used in making cores for piston-valve liners. These smaller cores are made in a core box which fits over the main core and while the loam is green. They thus become a part of the main core. With the smaller swept cores it is usually necessary to remove the spindle, in order that they can be located in their moulds without fouling the moulding box sides. It is therefore necessary to strengthen them by introducing irons during the process of sweeping, in the manner indicated previously when dealing with cores.

With large work it is customary to leave the hollow spindle in the core, and, where necessary, grids may be wedged to it in order to carry heavier bodies of loam. In some instances, usually in very large work, after the core has been made and dried a thickness equal to the thickness of metal is swept on to form a pattern. This practice is advantageous when only one casting is required or when it necessitates an out size in spindle and only one is available, or when the facilities for stoving work are limited. An example of this type is shown in Fig. 29. When the mould has been made from such a loam pattern the outer thickness is removed leaving the core.

RECENT DISCOVERIES of changes in iron and steel were referred to in a lecture at Sheffield on February 27 by Prof. F. C. Thompson, of Manchester University. A series of new critical points in iron and steel had, he said, been discovered from measurements of the electrical resistance at temperatures above the normal. These critical points, which occurred at temperatures of 70, 120, 170, 220 and 250 deg. C. had a profound influence on the mechanical properties. In particular the influence was felt in connection with the elastic limit in torsion and the modules of rigidity in torsion. Whenever one of these points was found there was a sudden and profound drop in the elastic limit, and hardness and ductility were also affected. His explanation of the phenomena was changes inside the atom itself.

XUM

Surface and Internal Defects in Iron Castings.*

Their Relationship, Cause and Cure.

By J. E. Fletcher, M.I.Mech.E., M.I.Brit.F.

The defects in every type of iron castings resulting from troubles, more or less preventible, in the preparation of the metal or its mould, or a combination of metal and mould, are at once the anxiety of every foundryman.

First, the raw materials, either as naturally obtainable or as supplied in a semi-worked condition, are but rarely of the uniform chemical or physical composition or in the state scientifically and practically desirable.

Secondly, the apparatus for smelting and remelting the ores and metals have a low efficiency when critically examined; that is, so far as affects the quality of the products, which are, in a very real sense, of variable characteristics.

Similarly, the refractory materials constituting the mould are irregular in chemical, mineralogical and physical condition, and too often the requirements in the way of giving sands and refractory clays the necessary uniformity of grain size, bonding strength, gas permeability, and refractoriness are badly understood. As a consequence, the mould may be entirely unsuited to the contact attack of a metal, whose temperature may be sufficiently high to cause partial fusion of the sand surfaces or, owing to insufficient permeability, to drive the gases held by the sand into the metal, with, not infrequently, disastrous results.

Thirdly, the human factor, of course, plays a part of primary importance in the realm of the foundry, and in no industry is accurate judgment and intelligent craftsmanship of greater importance than in this. Carbon, phosphorus, sulphur and manganese may vary in every pig charged into a cupola. The ingredients and the physical properties of a moulding or core-sand mixture may differ from point to point in a mould. The lining bricks or ganister-daubed well of a cupola may be, when partially fused, the most heterogeneous conglomeration imaginable. All such variations from a satisfactory mean may cause a host of troubles and be responsible for many casting defects, but the losses resulting from lack of intelligent craftsmanship, whether such skill be exercised in designing the casting, determining the method of moulding, gating, pouring and feeding, in actually ramming the mould and affixing its cores, in charging the cupola and controlling its operation, in fluxing and slagging the charges, or in skimming and pouring the metal into its mould, are infinitely greater than any which, in a well-controlled foundry, result from the usual variations in metal, sand and refractory composition.

Perhaps, of all the losses accruing from defective craftsmanship, the greatest is the result of ignorance in the matter of casting design, largely because the designer has but rarely considered carefully the moulder's and the melter's art, or the fundamentally-important metallurgical phenomena associated with contraction, shrinkage and cooling, as related to mass and form.

Cause of Defects.

It may be stated with certainty that both internal and surface defects in iron castings—as, indeed, in any metal castings—may be due to improper composition of the metal, to lack of fluidity and gas inclusion, incorrect casting temperatures, or to the heterogeneity of the metal. Or, again, such defects may result from the sand used in mould or core being of unsuitable composition, impermeability to gases or insufficiently refractory, too rigid when hot to yield to contraction nip, or too weak physically or refractorily to withstand the erosion of the metal streams. More often the defects, more or less encouraged by defects in the metal or the sand, are due to jointing a pattern wrongly, whereby the position of runners and risers is incorrect. Or cores may be so located that ventilation is impossible or defective. The size, shape or position of running gits and risers may be productive of mould erosion, gas trapping, or cooled viscous metal leading to faint running and cold shuts. Or risers may be too small or placed so far away from massive portions of the casting that feeding is impossible, the risers freezing before the mass of metal is fed and cavities resulting.

Again, the casting may be so designed that it is impossible to place runners and risers in positions where proper feeding of the thicker portions can take place. Cases are not infrequent where the only method of moulding possible places heavy sections in the bottom part of the box, the cope or top part taking thinner sections and giving no chance of feeding the casting.

In many of the intricate designs developed recently in automobile gas-engine and turbine work, the greatest difficulties are being encountered, especially as in some cases the ordinary run of fluid grey iron cannot be used, because they are unsuitable in the matter of withstanding high temperatures. It will be readily understood that, in such cases, the assurance of perfect solidity in thin-walled, intricately-cored castings cast in metals of a somewhat viscous character is a difficulty not easily surmounted, and the importance of design is paramount.

Perfect Metal and Moulds Defined.

The perfect metal for the founder's use would be one which, being gas free, structurally homogeneous, in both liquid and solid conditions, solidifies instantaneously without expansion or contraction, and cools without shrinkage or contraction. To obtain a skin perfectly free from defects the mould and core material would need to be truly refractory, able to withstand the metal temperature without expansion or contraction, and free from any tendency to adhere to the casting or to promote gas flow from mould to the fluid metal of the perfect character desired.

It is in the study of the variations wherein metals and moulds depart from the ideal, and the methods by which such ideal conditions can be approached, that the foundryman must hope to progress. It will be worth while briefly to indicate the divergences from the ideal existing in the metal and its mould.

Heterogeneity in Blast Furnace Practice.

(1) The metal produced from the ores in the blast furnace cannot be homogeneous, because the ores themselves are not available in a state of physically or chemically uniform composition; nor is the fuel. The air for combustion varies in moisture content and temperature, and oscillates in quantity, during each cycle of stove reversals (except in the case of cold-blast irons). Hence the character of the spongy iron arriving at the fusion zone is variable in carbon content, and, as the composition of the slags through which the elements—silicon, manganese, sulphur and phosphorus—enter, or are prevented from entering, the metal fluctuates, the product varies with the changes in the ore composition. The mass of metal in the furnace hearth is a mixture of many alloys—a collection of innumerable streams of variously-composed metals. If perfect interdiffusion of such a collection of grades of cast iron were possible, then the mean of the mixture should be of homogeneous character. But the varying analyses of metal found in any one pig bed and the difference in composition of any two successive casts, though smelted from the same ore and fuel burden, and under apparently similar blast and temperature conditions, points to the obvious fact that diffusion is not perfect, and the resulting pig-iron is not of homogeneous composition Climate variations affecting the moisture content of blast and burden, and the combined carbon content of the pig-iron, as cast in cold damp moulds, or in hot dry ones, the often irregular disposition of fluxes in the furnace burden, and the heterogene-

* A Paper presented to the Sheffield Branch of the Institution of British Foundrymen, Dr. T. Swinden in the chair.

ous mixture of finely-divided ore, bulky ore, and coke lumps in the burden, all prevent the possibility of homogeneous products. Hence the difficulty of the pig-iron maker in the close grading of his products. It does not need much extension of such a study to realise further that the difference between high and low speeds of production must further influence the variation between actual and ideal compositions of pig-iron.

Variables in Cupola Practice.

(2) The next step to be considered is the remelting of the pig-irons which, as already shown, cannot be ideally uniform in composition. In that small blast furnace, the cupola, the possible variation in the fuel, pig-iron and scrap burden is almost, if not quite, as likely to yield non-uniformity of product as is the blast-operated smelting furnace. With the difficulty of assuring a uniformly perfect charging cycle, combined with the variable speed of melting of different kinds of pig-iron and scrap, there is the certainty of an imperfect diffusion of the varied molten constituents as they collect in the well of the cupola, and the uncertainty that such lack of diffusion is altered later in the ladle or in the mould. Before leaving the cupola problem, it needs little imagination to conceive the effect of the universally acknowledged unknown quality of foundry scrap in its influence on the attempted production of an ideal metal. In this last detail the influence of repeated remeltings, with the constant accumulations of sulphur, should very seriously affect the conclusions too often arrived at, or worked upon, concerning the usually-accepted ideas with respect to the advantages accruing from repeated melting of cast iron, which are mainly dependent on silicon reduction.

Critically considered, the cupola, though the cheapest form of remelting furnace, is a very defective apparatus at its best, but if badly designed and carelessly operated, is capable of yielding metal which can present all the most undesirable properties associated with surface and internal defects when run into moulds.

Heterogeneity of Cast Iron.

(3) Apart from the fact that, as a result of non-ideal conditions in the blast furnace and cupola operations, the metal, as it is prepared for casting in the foundry moulds, is not ideally homogeneous, it is necessary to go much further in the search for a perfect metal. In its molten composition, cast iron contains a number of greatly divergent constituents, divergent in very important characteristics, such as viscosity, density, and in the power to dissolve gases. The fact that in certain cast iron one constituent of the molten metal may freeze at 1,300 deg. C., another at 1,130 deg. C., and still another at 950 deg. C., each constituent being possessed of different density, viscosity and contraction, should indicate the complexity of the shrinkage problem as influenced by the chemical and physical differences in the metal composition.

Question of Gases.

(4) Again, all cast iron contains gases in solution or in the free state, and these, apart from the part played by the metal and metalloids present, influence the viscosity, density and contraction.

In the case of water, there is ordinarily an expansion when freezing occurs, but, as Osmond has shown, when the air or vapour is removed by pumping from the liquid, the expansion during freezing is absent. Bessemer showed that liquid steel in the converter might be quiescent; yet, on relieving the air pressure by vacuum methods, vigorous boiling begins, which could be stopped by subjecting the liquid metal to superincumbent gas pressure. Brinell, in an examination of defects in steel ingots, observed that temperature of melting or pouring and the absence of silicon, manganese, or aluminium in the steel lead to blow-holes or cavities. From his important researches it is clear that the speed of cooling influences the position and volumes of defects, which are distinctly traceable to gas inclusion.

It is well known that "wild" or badly-melted steel, especially if too low in silicon and manganese contents, occupies much more ingot volume than the same weight of "dead melted" or "well-killed steel." The addition of aluminium will cause the surface of such "wild" steel to fall five or six inches (sometimes more) in the ingot mould.

The gases liberated in the molten steel were considered by Brinell to be largely due to the presence of iron oxide (FeO) dissolved in the metal, and many metallurgists have considered that the gases are liberated by the reaction between the iron oxide (FeO) and carbon in the metal, thus:—

$$FeO+C=CO+Fe.$$

Indeed, when this phase of the subject is considered critically, the vital importance of the fact that ferrous oxide is absorbed by the metal in all smelting, melting and refining processes suggests that possibly most of the imprisoned CO and CO_2 gases in molten ferrous metals are the product of the reaction between carbon and ferrous oxide, H and N being probably the result of blast action in the tuyere zones of the blast furnace.

The researches on the nature and volume of gases imprisoned or dissolved in cast iron and steel, though of great interest, are very vaguely complete, for it is extremely unlikely that the gases withdrawn from the surface of molten metal by vacuum methods represent the whole, for obviously there must be much remaining, and this of different composition to that which readily escapes. Experiments have shown that the gas analysis varies as the metal cools; also that the gases collected from solid cold steel and cast iron are different in composition from those obtained by vacuum methods from the liquid metals.

Slag Inclusions.

It would appear, therefore, that during the whole time the metal is cooling from high-superheat temperatures to that of solidification, reactions between included or dissolved FeO and the dissolved carbon proceed. It is not unlikely that other reactions between the metalloids, the FeO and the liberated CO gas, continue during the same period, and here, as a result, minute slag particles of MnO and SiO_2 will be liberated. This is strongly suggested by the presence of buttons of slag largely composed of a silicate of manganese—$MnO.SiO_2$ or $2MnO.SiO_2$+SiC_8—in the bottom of "pipe" cavities in large steel ingots and in the small segregational specks in other slow-cooling positions. The writer found such buttons to contain 40 to 45 per cent. SiO_2, 45 to 55 per cent. MnO, with 5 to 7 per cent. Al_2O_3, when aluminium has been used as a deoxidiser. Similar indusions are not infrequent in over-blown cupola metal.

It cannot be doubted that ferrous oxide is often produced in cupola melting, as in all pneumatic processes, and, wherever this is the case, the metal must become gas charged as a consequence of the action of the FeO on the carbon in the cast iron. Whenever this happens, the viscosity of the metal is affected and porosity encouraged.

J. E. Johnson, jun., has purposely added metal overblown in a Bessemer converter to grey cast iron, and as a result has encouraged the reaction

$$FeO+C=CO+Fe.$$

He found that the free carbon thus oxidised was an advantage, for he obtained a low-carbon cast iron possessing a structure remarkably free from large graphitic flakes and approximating to charcoal cold-blast iron in character.

In the production of so-called "semi-steel" a similar action often occurs, but whenever this is due to overheating the troubles resulting from viscous metal appear in the shrinkage defects in the grey iron castings produced.

How Impurities Exist.

(5) Reverting to the presence of constituents other than metallic iron in castings, it is useful to remember that in the liquid state carbon, silicon, phosphorus and sulphur are probably present combined as iron carbides, silicides, phosphides and sulphides. It is exceedingly unlikely that the metalloids occur in liquid cast iron in the free state. The compounds named, together with manganese carbide and manganese sulphide, when they solidify do so as partners in various groups of constituents.

(To be continued.)

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

VOLUME CHANGES OF CAST IRON ON SOLIDIFICATION.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Before replying to the questions raised by Mr. S. G. Smith and "Foundryman," may I express my appreciation of the excellent way in which you have reproduced the paper, and recognise the time and attention devoted to its preparation. May I also correct a slight discrepancy regarding the position of photos A and B, Fig. 61. These should be reversed to substantiate the reading of the paragraph following.

In reply to Mr. S. G. Smith's kindly criticism, I feel that in coming from such a well-known authority my work has not been in vain.

Temperature Gas Balance Re-action.

To express this concisely, so that the ordinary foundryman may understand clearly what is meant, is not easy. I will endeavour to do so, however, by a few practical illustrations.

At the outset let it be understood that metals and alloys absorb quantities of gas both in the solid and liquid state. Steel, *e.g.*, absorbs considerable hydrogen when immersed in sulphuric acid, which gas may embrittle it to a remarkable extent. If we melt fine silver in air, it absorbs about 22 times its volume of oxygen from the atmosphere. On solidification, silver so melted "spits." The cause of this spitting is the expulsion of the oxygen it absorbed during melting. Similarly, molten steel, copper, nickel, brass and cast iron absorb many times their own volume of gas, the solubility of which steadily increases with a rising temperature and decreases as the temperature falls from melting to pouring. It is also known that with regard to steel, Al, Si, Ti and Mn prevent the evolution of occluded or dissolved gas during solidification and so "kill" the steel. Other elements tend to reduce the solubility of the gases absorbed during melting, *e.g.*, vanadium behaves in this way. This also applies to cast iron, which under certain conditions has been found to dissolve as much as 346 times its own volume of gas. The quantity of gas dissolved by cupola-melted cast iron is a variable determined by the:—(1) Melting conditions, (2) grades of iron, (3) chemical composition of the cast iron used, (4) quantity of steel used, and (5) temperature of melting, whilst the proportion of gas retained in the solid iron is a function of the pouring temperature and rate of solidification. To exemplify; cast iron poured at too low a temperature will produce unsound castings, presenting porosity, blow-holes, and sink-holes, defects which will be more pronounced the slower the iron is cooled during solidification. On the other hand, if poured too hot and solidified too rapidly, the castings will be badly blown. This means that in the first instance, a reaction takes place between the constituents present in cast iron, and the dissolved gas at certain temperatures, and in the second, that the quantity of gas which can be retained in solid cast iron is limited. As the experiments show, the liquid shrinkage of cool iron is higher than that of hot iron, and the quantity of dissolved gas contained in any grade of cast iron is a function of its temperature.

For this reason, in the original paper, considerable attention was devoted to actual pouring temperature and to the determination of the freezing points of typical irons, fundamentals which cannot be expressed by such vapid terms as "hot" and "cold," which convey no real meaning. The importance of the variation in the liquid shrinkage caused by a fall in temperature is demonstrated by any large casting which is run from the bottom. It will be found that the iron at the top of the casting farthest away from the ingates, invariably draws more than any other portion of the casting. An appreciation of the relative temperatures of solidification and the latent heat of fusion of the various cast irons used to-day is absolutely essential if the foundryman is to gain any understanding of the technology of this balance reaction between the constituents present and the dissolved gas. Unfortunately, the subject is too technical to be more than cursorily surveyed here, but *a study of the reactions which could take place between each of the gases present in the cupola at various temperatures and the various grades of cast iron;* and also *a correlation of furnace gases, melting conditions and the properties of resultant castings,* are the two urgent problems for future research, and necessary to a better understanding of the constitutional changes which operate in molten cast iron during solidification.

With regard to the experiment outlined in Fig. 14, increasing the area of the ingate and using dull metal would not have improved matters. Hot metal is essential to the production of clean castings, irrespective of rate of running, and with the form of casting used in the illustration referred to, cold metal would result in both blow-holes and local contraction consequent on the above reasoning. The degree to which the defects would manifest themselves would be a function of the temperature at which the metal was melted, its chemical composition, the temperature of pouring, and the rapidity of solidification.

Transference of Draws.

If Mr. S. G. Smith will kindly refer to my paper he will see that my remarks do not apply to permanent moulds.

I read, with great interest, Mr. Smith's valued article in the FOUNDRY TRADE JOURNAL, July, 1914, dealing briefly with chilling in loam and sand work. He says: "The effect of the chill is to assist the thick section to solidify more rapidly, by absorbing the heat, thus making the cooling of the thin and thick sections more uniform in rate, and although some porosity may exist in the centre of the thick section, it is more than counterbalanced by the close-grained iron of the surface next to the chill. Also, when chills are used in this way, there is no appearance of draw, crack or draw-holes on the surface." As information with regard to the temperature of pouring is not forthcoming, I would suggest that Mr. Smith's trouble in that particular instance was due to the falling temperature of the metal in the mould, and as the liquid shrinkage correspondingly increases no amount of chilling will eliminate the draws referred to. The problem is exactly the same as the casting cited in the paper with reference to the experiments on casting temperature, and it is for the same reason that one encounters shrink holes in the upper portions of a casting which may have been poured slowly from the bottom.

In reference to Mr. Smith's article, July 26, 1922, unless more detailed information is given regarding the dimensions of the casting, the method of running, and pouring temperature of his metal, it is impossible for me to make any comment, but from the composition given, chilling would not eliminate drawing, no matter at what temperature it was poured, as the iron has a natural shrinkage, and the only safe remedy was that resorted to, viz., feeding. Similarly is his reasoning sound in his article of October 5, 1922 (steam chest). I can confidently recommend these articles to any foundry man who has such a problem, because they illustrate practically the best means for eliminating porosity and draw-holes under the conditions stated.

Risers.

I strongly endorse Mr. Smith's remarks; the object of showing illustrations A and C, Fig. 35, and B, Fig. 45, was to demonstrate the points raised by him.

Runners.

The disposition of the runner is one of the most important factors in the production of solid castings, and Mr. Smith's illustrations in his numerous contributions fully demonstrate this.

Top Pouring.

May I correct Mr. Smith's error here? The metal was not excessively hot, the temperature of pouring being 1,350 deg. C. for the hard cylinder iron, not 1,450 deg. C.

Pouring Jet Area.

May I refer Mr. S. G. Smith to my reply to Mr. James Smith in the discussion of the paper at Newcastle?

Degree of Superheat.

This expresses the amount of available heat in molten iron for casting purposes. To illustrate, assume the iron begins to solidify at 1,200 deg. C. To pour with 10 per cent. superheat means 1,200 deg. C. plus (10 per cent. × 1,200) = 1,320 deg. C. Thus when any percentage of superheat is referred to in the paper, the actual temperature in centigrade is obtained by reference to Table 2 and adding the degree of superheat stated.

Minimum Critical Rate of Cooling Necessary to Uniform Solidity.

In the near future I hope to be able to produce a series of curves which will express in seconds the minimum time figure during solidification necessary to produce a certain degree of solidity with the commoner grades of cast iron when poured with different degrees of superheat. I think the cube experiments in my paper demonstrate the meaning of the expression to the more practical mind. These experiments show a 6-in. cube of cast iron, cast in dry sand without feeding is open and spongy, which if cast in a mould lined with a 1-in. steel plate is uniformly solid throughout. Thus the minimum cooling rate necessary to uniform solidity had been obtained in the latter but not in the former.

Figs. 47 and 48 illustrate another similar example. Figs. 39, 40 and 41 show how the minimum critical rate of cooling is affected by the composition of the iron, and how the soft grey iron with its wider range of freezing temperature and higher latent heat value is responsible for slower solidification than obtains in the hard cylinder iron.

In reply to "Foundryman's" first question, viz.:—"Is not casting hot with a small runner the same as pouring cooler with a large runner?" I refer him to the first part of my reply to Mr. S. G. Smith, and suggest that the four problems of liquid shrinkage dealt with in my paper, viz., *pouring temperature, rate of solidification, chemical composition* and *rate of running* be considered quite separately before taking them together in a general way. Unless this is done one must resort to forming views or opinions which lead to unprofitable controversy. After close study of the experiments on each of the above four problems, I had trusted that they afforded conclusive evidence that casting hot with a small runner is not the same as pouring cooler with a larger runner. "Foundryman's" question involves three of the above four factors, viz., *pouring temperature, rate of solidification* and *rate of running*. In the experiments on *temperature effect*, it is shown that there is a constitutional change in molten cast iron after it leaves the cupola, which is responsible for the greater liquid contraction of cool iron. In considering the *rate of solidification*, unless a specific form of casting is mentioned and the method of running illustrated, one cannot presume that quickly-run cool iron would solidify more rapidly than the slowly-run hot iron, or *vice versa*. With regard to the effect of *rate of running*, I will cite a simple ingot of steel or brass. By filling the mould quickly one gets a distinct pipe due to natural shrinkage. Pour from the top slowly, so as to ensure as far as possible a uniform solidification throughout, then the pipe will be eliminated. That is, the pipe due to liquid shrinkage is fed up as the ingot solidifies. Similarly, by modifying the method of running could the results of the contraction block experiments be varied.

The essential factor with these, however, was to obtain a known volume of molten iron, and measure the volume change on solidification. To obtain this and control the order of solidification, so that it should always be in the same place for the purposes of quantitative measurement, the form of mould and method of running shown by Fig. 13 was chosen after various exploratory experiments. Again, with regard to the question of dimension of ingates, its effect does not finish at the control of rate of feeding up or rate of solidification of the iron. It affects the mode of crystallisation.

If "Foundryman" will kindly read the sections of my reply to Mr. Paulin's questions, FOUNDRY TRADE JOURNAL, page 15, dealing with the "Effect of Phosphorus" and "Teeming Speeds," it will be seen that an explanation given for the increased solidity of castings poured by means of small jets is, that skeletal arms of the primary crystal grains may be reduced in dimension—just as obtains by gently agitating crystals of sugar which are just falling out of solution—and so permit of their closer packing, *i.e.*, its effect is to affect two of the three principal forces operating during the solidification of the metal in the mould, viz., crystallisation and liquation.

Should "Foundryman" care to demonstrate this in a more practical way, a cylindrical casting, such as a cylinder liner, piston valve liner or the like, may be used, a form which commonly exhibits an open patch after machining. Run one from the bottom with, say, one or two runners of suitable dimension, *i.e.*, over ½ in., and the other also from the bottom but by means of 12 tangentially-cut ¼-in. jets fed from two common down gates. He will find that the former invariably presents a porous patch, whilst the latter will be uniformly solid.

With regard to rate of cooling, "Foundryman's" comments are unquestionably correct. There is no doubt that the soundness of cast iron very often depends on the heat conductivity. I cannot concur with the suggestion that pouring hot metal through a small gate into an iron mould would give a similar effect as pouring cooler into a sand mould. I trust that I have satisfactorily explained why this is not so, and the fact can be demonstrated quite readily by anyone concerned. I was interested in the further comments of "Foundryman" that, "Given a very large block, no method of pouring or temperature can overcome the drawn place always found in the centre unless feeding is applied." This may be true for certain conditions, but one cannot satisfactorily feed solid a substance such as cast iron, which has a long freezing range, and which passes through a pasty or "mushy" stage before it solidifies, particularly when that "mushy" condition exists for any length of time.

Unless solidification of such large masses is speeded-up faster than a certain rate, it is almost impossible, commercially, to feed solid during the long period it is in the "mushy" condition. There are two ways of speeding up solidification, which offer themselves, the one by rapid extraction of the heat by means of mechanical chills, and modification of the method of moulding, the other by using an iron of short freezing-range and running through small jets, preferably from the top, so that the mould fills slowly.

I most strongly endorse "Foundryman's" comment that the nearer the "steel-white cast-iron series of irons" is approached, the greater provision is necessary to overcome drawn and faulty castings.

With regard to casting temperature, I think this appears to be more complicated than it really is. There is no reason why there should be any difficulties in this respect. The temperature of the metal is taken daily in the foundries of Sir W. G. Armstrong, Whitworth & Company, and actual measurement is the only method of settling controversies and ascertaining the real cause of any trouble.

The nearer the approach of cast iron to steel, the higher the temperature of incipient solidification. The following are placed in the order of the increasing temperature of solidification:—(1) Common grey iron, (2) ordinary cylinder iron, (3) hard cylinder iron, (4) malleable cast iron, (5) razor steel, (6) mild steel. Thus, as cast irons harden, the temperature at which they solidify increases, and in consequence must be cast at a correspondingly higher temperature, *e.g.*, iron No. 3, Table 2, which is a cylinder iron, begins to solidify at 1,232 deg. C., whilst iron No. 5, a common grey iron, begins to solidify at 1,165 deg. C., *i.e.*, 67 deg. C. lower than the harder cylinder iron. Hence, to cast both irons with, say 10 per cent. superheat, their relative pouring temperatures would be 1,355 deg. C., and 1,281 deg. C., respectively. Were there two grades of iron poured, say, at 1,281 deg. C., which may have proved suitable for the soft grey iron, the castings made from the cylinder iron, in this case a harder iron, would be defective. Hence the expression that "the harder the iron, the higher the temperature of solidification. Casting, therefore, must be performed at a correspondingly higher temperature."

Thanking the contributors for their criticism and

appreciation of the paper, and trusting that your readers will yet give their experiences, I can only conclude by a final expression of my gratitude to the Editor for his practical and helpful co-operation.

Yours, etc.,
D. SMALLEY.

FAKING TEST BARS.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—As a foundryman with considerable experience in making gun-metal castings to stand a pressure of 3,000 lbs., I read with amazement the remarks in the article on Test Bars in your issue dated February 22, under the sub-heading "Non-Ferrous Work," where the writer points out he had trouble with the test, and to overcome the trouble cast the bars separate of the same material (?) and burnt them on. I hope the writer does not claim to speak for non-ferrous foundries generally, when he says "We have to fake the results."

I should like to inform the writer of the article that our Barrow Foundry (Ogden & Lawson), during 1915 to 1919, made thousands of castings that were tested to 3,000 lbs. The composition was copper 87, and tin 13 per cent., and the overseer would not accept any castings unless a test bar was cast in the same box, and if the writer had had the overseer who had charge of taking tests from the Barrow foundries to deal with, he would not have found it an "easy matter" to bluff him with faked test bars. We made over 1,000 cylinders of various types both vertical and horizontal, and every one with the test bar moulded in the box, and all tested to 3,000 lbs. Not one single test bar, however, was faked or burnt on. Further than that, 95 per cent. of the tests passed the mechanical test and requirements of the British Admiralty. I can assure engineers that faking test bars is not a common practice in non-ferrous foundries; indeed, it is not necessary if foundrymen use care and judgment.—Yours, etc.,

WILLIAM LOWE,
(Manager)
Messrs. Ogden & Lawson,
Brass and Bronze Founders,
Barrow-in-Furness.
Feb. 27, 1923.

Moulding a 3-in. Grooved Pulley from a 2-in. Grooved Pattern.

The foundry is often called upon to produce castings with little or no pattern, or make one from existing patterns with much alteration, especially if only one casting is required. In such cases it is far more economical to put the extra time on the moulding than involve the entire cost of making a pattern, and this is where the true art of moulding is displayed. Some moulders have a natural aptitude for this class of work, but they are exceedingly rare. To these craftsmen it is a real joy when they are called upon to undertake some difficult and intricate piece of moulding.

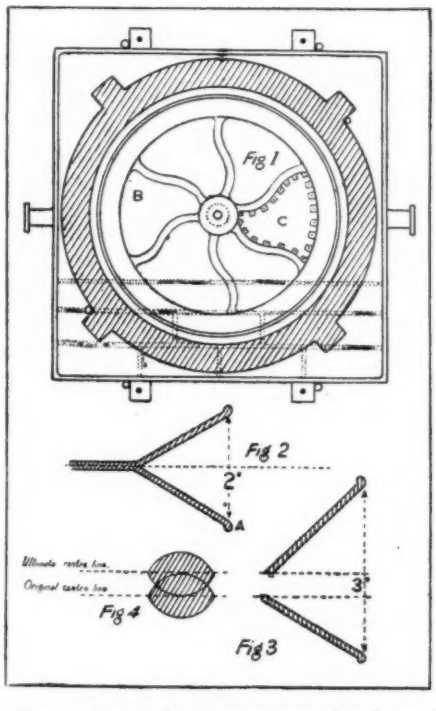
It is perhaps safe to say that the best type of foundry in which to learn the true art of moulding is the general jobbing foundry and, incidentally, the most difficult to run successfully on account of the variable character of the work undertaken, the lack of experience and tackle existing in such foundries.

The following description of moulding an ordinary rope wheel will serve to illustrate the foregoing remarks.

Fig. 1 shows the rope wheel with lifting ring and top part in position. The groove of this pattern is 2 in. (Fig. 2). The casting required from this calls for the groove to be 3 in., with the arms and boss quite central with the groove.

The method adopted was as follows:—The bottom part of the pattern was bedded in the floor, the lifting ring placed in position and the joint made round the edge of bottom rim (A, Fig. 2). A little slurry (clay wash) on the top of lifting ring helps to hold the sand, which is now placed on the ring and rim and patted down with the hand. Rods are placed on the sand all round the groove to carry the cod. Three pieces of wood are cut the shape of the groove and are 3 in. at deepest point; these are placed equidistant on the bottom rim, and the top rim placed upon them, thus ensuring the groove to be 3 in. in the opening. The whole is now rammed up and joints made. It will be noticed that the top rim of the pattern is out of centre with the arms and boss by $\frac{1}{2}$ in. (Fig. 3); as the arms are 1 in. thick it means that the joint must be made at the top of the arms, Fig. 4. The top part of moulding box is now placed on and rammed up, care being taken not to place any gaggers or lifting hooks where the top half of the arms are to be cut out.

The top part is carefully marked to ensure its being placed back correctly and lifted off. The ring cod is now vented, the top rim of pattern removed and the lifting ring and cod lifted away. The sand is then cut away from the arms to allow them to be withdrawn; the arm moulds are then filled up with loose sand and the pattern placed back and knocked down until the centre of the arms is level with the joint. This is made up properly and the pattern finally withdrawn. The mould is now finished and the ring put back, and now one can proceed to locate the arm in the top part; it is done as follows:—Small pieces



of paper about 1-in. square are placed on the joint following the contour of arms and the inside diameter of the rim, and on these small pieces of paper (buttons) just one spot of slurry (C Fig. 1) is dropped. The top is then placed on correctly, lightly pressed down, and then removed, and all the pieces of paper will adhere to the top giving the exact position for the top half of the arms to be cut out. This operation requires a fair amount of skill, so that no more or less than half the arms shall appear in the top; when the whole mould is finished it is closed and cast.

FURTHER DEVELOPMENTS are contemplated at the Renishaw ironworks, near Sheffield. A contract has been placed for a new blast furnace capable of an output of 1,000 tons a week, four Cowper stoves, and 32,000 cub. ft. per minute air compressor.

RECENTLY Robert Hudson, Limited, secured an order approximately £350,000 in value from the Portuguese West African Government for track material. This has been supplemented by a further order from the same source for 350 kilometres of track material, making the total value of the order £878,000.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron market at the moment are very far from satisfactory, smelters having practically no supplies available for disposal, either for prompt or March/April deliveries, and are consequently declining business until the fuel position becomes more clearly defined. Merchants also, are assuming an extremely cautious attitude, and consumers generally are restricted to hand-to-mouth dealings whenever opportunity offers. The question of coke supplies is, of course, the dominant factor in the situation, several furnaces which might have been re-lighted, remaining compulsorily idle pending an assurance of sufficient quantities of fuel for working. To add to the existing difficulties of the position imports of foreign pig are almost unobtainable, the majority of producers abroad suffering also from lack of essential fuel, while America has hardly yet sufficiently recovered from recent labour difficulties to supply the deficiency. There is, however, undoubtedly an increasing inquiry for foundry iron from the Continent, and some substantial sales have been been put through. Buyers abroad have hesitated to follow the recent advances, but they are now finding themselves compelled to come in at even enhanced figures.

The shipments of pig-iron from the port of Middlesbrough (including Skinningrove, 5,664 tons) during February amounted to 39,406 tons, as compared with 41,308 tons in January, a decrease of 1,902 tons. Germany was the biggest customer with 8,019 tons, against 2,185 tons in January, and the U.S.A. took 6,258 tons, as compared with 5,342 tons. Belgium received 3,025 tons, against 3,377 tons; France, 2,255 tons, against 1,405 tons; and Italy, 2,820 tons, against 7,500 tons. Only 1,830 tons went to Scotland, but Wales took 3,880 tons.

On Tees-side there is an insistent demand for hematite, for home consumption even more than for export, which makers are quite unable to meet. Makers are heavily committed up till May, and are not disposed to book any further ahead. There is a big export inquiry, but a good deal of this is neglected owing to the necessity of protecting home customers' interests.

MANCHESTER.—The foundry iron trade in Lancashire, in common with that of other localities is experiencing considerable difficulty in meeting requirements, famine conditions in the Cleveland district having induced some Midland makers to transfer their attention to the Cleveland market, where the prices realised are now much higher than can be obtained elsewhere. The question of immediate interest to local ironfounders is whether very much Midland foundry iron will find its way out of this district to Middlesbrough, because, if so, it is clear that the price in Manchester will rise.

THE MIDLANDS.—Business in all qualities of pig-iron in this area is on a restricted scale, not because demand has diminished, but for the reason that producers have very limited supplies available, and in some cases are even temporarily out of the market. Some well-known South Staffordshire firms, for instance, are not submitting quotations for the time being, having already sold heavily on forward account, while owing to the shortage of fuel, outputs are only maintained with extreme difficulty. In these circumstances it is very difficult to furnish anything like reliable quotations. Of course, what little iron may become available for prompt delivery commands a very high price, and unless there is a very considerable change in the international situation it is impossible to foresee how far the upward movement will go.

SCOTLAND.—The upward movement in pig-iron values in the Clydeside area continues unchecked, the minimum quotations last week-end representing a basis of 115s., f.o.t., furnaces for No. 3 Scotch, with sellers very cautious. Local consumers of Cleveland iron are finding practically none on offer, and what sellers there are have evidently very varied notions as to the value of the iron they have to dispose of.

Finished Iron.

Steady improvement may again be noted in this section of the iron industry, the volume of inquiries in circulation indicating a satisfactory increase in demand, while most of the mills and forges are making gradual headway towards normal capacity outputs. In every branch of the industry, however, manufacturers are experiencing increasing difficulty in maintaining regular and adequate deliveries of pig-iron against contracts. They have to be very energetic in looking up supplies, or the mills would come to a standstill in some cases.

Steel.

A steady improving demand is still in evidence for most descriptions of steel products, the inquiries for both basic and acid billets continuing in unabated strength, both on account of home and overseas consumers, with prices again advanced in the chief markets. The cheapest soft steel billets at the moment are obtainable in Wales, where the makers are quoting round £8 per ton, but elsewhere the price runs up to £10. Sheet bars are also advancing, and although in Wales the price is fixed at £8 to £8 5s., elsewhere as much as £8 12s. 6d. is willingly paid. At Sheffield, quotations remain at last week's level, but buyers do not expect to secure supplies except at a fairly substantial advance. With Lincolnshire makers declining orders, Yorkshire billet makers are overwhelmed with business, and are unable to handle it all. The open-hearth furnaces are practically all in operation now, and even crucible steel is making headway. In the market for ferro-alloys the situation with regard to pig-iron and the near future also affects ferro-manganese. There is an increasing export demand for both the Continent and America, and with increasing cost of coke, etc., current quotations, as anticipated would be the case, have been advanced £1. Most producers are well booked for March and April, and are said to be not very anxious to book farther ahead under present conditions.

Metals.

Copper.—Movements in the market for standard copper have again favoured an upward tendency and quotations were substantially advanced on the week. Heavy buying on both home and American account was strongly in evidence, based mainly, it is suggested, on consumers' increased demands, together with active speculative dealings on both sides of the Atlantic. It is at all events certain that a large business has been transacted in options, and a good deal of the present activity may be ascribed to such dealings. It is difficult to say to what extent the prevailing spirit of optimism is justified, but values appear to be ascending in a manner out of proportion to the position in this country, and a reaction is by no means improbable. Current quotations :—*Cash* : Wednesday, £72 7s. 6d.; Thursday, £73 7s. 6d.; Friday, £73 15s.; Monday, £73 5s.; Tuesday, £72 12s. 6d. *Three Months* : Wednesday, £73; Thursday, £74; Friday, £74 7s. 6d.; Monday, £73 15s.; Tuesday, £73 7s. 6d.

Tin.—Markets during the past week have been unusually active, and under the influence of a strong "bullish" tendency values have spurted daily, quotations for standard tin having marked an advance since the beginning of February of nearly £30 per ton. A fair amount of buying has been transacted on account of home consumers, though not enough in itself to warrant the sharp advance which has taken place, much of the buying having been of a speculative nature in anticipation of a favourable showing in the monthly statistics. This, however, has now been largely anticipated. It would seem, therefore, that under all the circumstances a reaction is overdue. Current quotations :—*Cash* : Wednesday, £209 5s.; Thursday, £211 10s.; Friday, £208 10s.; Monday, £208 17s. 6d.; Tuesday, £211 15s. *Three Months* : Wednesday, £210 5s.; Thursday, £212; Friday, £210; Monday, £210 5s.; Tuesday, £212 15s.

Spelter.—In common with other metals, the market for spelter has continued fairly active, although without notable change in the general position. Business in America keeps firm, as also on the Continent, and producers display no anxiety to press sales. The tendency of the market is, however, a little uncertain, having in view increasing output, and the possibility that consumption may not develop sufficiently to absorb, at present prices, whatever surplus there may arise. Current quotations :—*Ordinary* : Wednesday, £37 2s. 6d.; Thursday, £37 2s. 6d.; Friday, £37; Monday, £36 17s. 6d.; Tuesday, £36 11s. 3d.

Lead.—The market for soft foreign pig continues firm, although business, on the whole, is somewhat quiet, the present high values curtailing business, with buying on a hand-to-mouth scale. Current quotations :—*Soft foreign (prompt)* : Wednesday, £29 5s.; Thursday, £29 2s. 6d.; Friday, £29 5s.; Monday, £29 7s. 6d.; Tuesday, £29 11s. 3d.

XUM

Trade Talk.

DORMAN, LONG & COMPANY, LIMITED, are preparing to restart two of their blast furnaces at Redcar.

MR. E. J. SILCOCK, of London and Leeds, has removed his London office from 17, Victoria Street, to 25, Victoria Street, Westminster.

ELTON, LEVY & COMPANY, LIMITED, metal merchants and brokers, of Brettenham Road, Edmonton, London, N.18, have established a branch in Birmingham.

CONSIDERABLE DAMAGE was caused by a fire, on February 25, at the Wardsend Steel Works, Owlerton, Sheffield. The engine-house was practically gutted.

LICENCES UNDER THE NON-FERROUS METAL INDUSTRY ACT (1918) have been granted to R. W. Peel, of Salford; and the Phœnix Metal Company, Overton, Sketty, Swansea.

SIR HENRY MATHER JACKSON has resigned his position as a director of the Ebbw Vale Steel, Iron & Coal Company, Limited, and of the other companies connected with it.

BROWETT, LINDLEY & COMPANY, LIMITED, propose to increase the dividend on the preference shares from 6 to 7 per cent., provided holders agree to relinquish the right to share in surplus assets in a winding-up.

THE BARROW HEMATITE STEEL COMPANY, LIMITED, have appointed Goodwin & Company (No. 2 Dept.), of 53, Queen Street, Sheffield, agents in the Sheffield district for the sale of their Siemens acid semi-products.

MR. S. H. MORDEN has resigned his appointment as director and manager of H. J. Skelton & Company, Limited, and has joined the firm of J. Whittall & Company, Limited, engineers and merchants, of 9, Fenchurch Avenue, London, E.C.

PROFESSOR C. H. DESCH, of Sheffield University, gave an illustrated lecture on "Plastic Flow in Metals" to the Sheffield and district local section of the Junior Institution of Engineers, at the Cutlers' Hall, Sheffield, on February 23.

OWING TO THE scarcity of coke, the United Steel Companies, Limited, have been compelled to damp down a furnace at Workington. Consequently their steel works at Moss Bay, which were recently restarted, will have to be closed down.

MR. J. H. S. DICKENSON lectured before the members of the Sheffield branch of the Association of Engineering and Shipbuilding Draughtsmen, at the Angel Hotel, Sheffield, on February 23, on "The Mechanical Testing of Steel." Mr. G. Wardle presided.

THE ANNUAL DINNER of the ex-British Westinghouse Association will take place on Friday, March 9, at the Holborn Restaurant, London, W.C. Mr. A. R. Dyer, chief officer of the London Fire Brigade, will preside. The hon. secretary is Mr. L. S. Richardson, 14, Sydney Road, Richmond.

Obituary.

MR. W. G. TAYLOR, managing director of Taylors, Limited, Driffield, ironfounders, and of C. H. Taylors, Leeds, died at his residence in Bridlington, on February 22, aged 55 years.

MR. C. E. ROBERTS, a brother of Mr. F. O. Roberts, M.P. for West Bromwich, whose death is reported, held a responsible position with the firm of N. Hingley & Sons, Limited, Netherton, Dudley.

MR. JOHN R. BELL, joint managing director of Grant, Ritchie & Company, Limited, engineers, Townholm, Kilmarnock, has died as the result of an assault which was alleged to have been committed upon him by an apprentice engineer in the works. The deceased, who was under 50 years of age, was a native of Motherwell.

MR. JOHN AUGUST DIEDERICH BORNEMANN, a director of Ruston & Hornby, Limited, died at his residence, The Avenue, Lincoln, recently. Born at Amsterdam 69 years ago, Mr. Bornemann was elected managing director of Ruston & Hornby in 1896 in succession to the late Mr. John Kent. He retired from that position in 1919, but remained on the directorate.

MR. WILLIAM GRICE, of Aldworth, Church Road, Yardley, has died in his 91st year. Mr. Grice, who was born in Birmingham, was the founder of the firm of William Grice & Sons, Limited, iron founders, Minerva Works, Fazeley Street, and prior to his retirement, many years ago, was well known in business circles in the town.

MR. W. R. RENSHAW died at his residence, Northcote House, Stoke-on-Trent, on February 26. The deceased gentleman, who was 78 years of age, remained at his business until a fortnight before his death. He was one of the partners in the firm of Renshaw, King & Company, of Kidsgrove, ironfounders, to which firm he was apprenticed in his younger days.

Company News.

J. C. Parkes & Sons, Limited.—Dividend, 8 per cent. per annum; carry forward, £3,451.

Scottish Iron & Steel Company, Limited.—Dividend on ordinary, 6 per cent., less tax, for 1922.

R. & W. Hawthorn, Leslie & Company, Limited.—Interim ordinary dividend, 5 per cent. per annum.

Alldays & Onions, Limited.—Loss, £78,636; directors propose creation of third debenture stock for £50,000.

Bruce Peebles & Company, Limited.—Ordinary dividend for year, 10 per cent., less tax; bonus, 5 per cent., less tax.

Yorkshire Engine Company, Limited.—Net profits, £8,520; brought forward, £29,402; ordinary dividend, 5 per cent.; reserve, £10,000; carry forward, £24,176.

British Metal Corporation, Limited. — Profit, £178,110; brought forward, £11,979; reserve, £100,000; available, £90,089; dividend, 8 per cent., less tax; carry forward, £14,010.

North British Locomotive Company, Limited.—Preference dividend for half-year, 2½ per cent., less tax, making 5 per cent., less, for year; ordinary dividend, 7½ per cent., free of tax.

Vickers, Limited.—Final dividends for half-year ended December 31:—2½ per cent. preferred 5 per cent. stock (less tax); 2½ per cent. on 5 per cent. preference shares (less tax); 2½ per cent. on cumulative preference shares (free of tax up to 6s. in £).

Henry Bessemer & Company, Limited.—Net loss last year, £10,949; no dividend; workmen's compensation reserve fund, amounting to £18,338, added to reserve fund, increasing it to £77,133; Bessemer plant dismantled and £5,324 taken from general reserve fund and written off for depreciation of machinery and plant.

Scottish Power Company, Limited.—Profit, adding £2,695 brought forward, £30,785; loan and debenture interest, £4,145; redemption of debenture stock, £830; dividend on preference, 8 per cent. per annum (less tax), £11,878; reserve, £4,000; ordinary dividend, 8 per cent. per annum (less tax), £7,433; carried forward, £2,498.

Delta Metal Company, Limited.—To meet special liabilities incurred in respect of preceding years, special sum of £4,318 representing excess over liabilities being contingency fund drawn upon to extent of £20,000, transferred to profit and loss account; balance available, £10,856; brought forward, £10,094; dividend for year, 7½ per cent. per annum, free of tax; carry forward, £7,450.

Gazette.

A WINDING-UP ORDER has been made against the Engineering Products Company, Limited, 97, Pembroke Street, Copenhagen Street, Caledonian Road, N.

TRADING UNDER THE STYLE of Phelps & Bluck, Messrs. S. Phelps and W. H. Bluck, Hatherton Street, Walsall, engineers, have dissolved partnership. Debts by Mr. W. H. Bluck.

TRADING UNDER THE STYLE of the Shirreff Timesavers Company, Messrs. A. F. Shirreff and G. U. Farrant, Bawdrip, nr. Bridgwater, engineers, have dissolved partnership. Debts by Mr. A. F. Shirreff.

THE ADJUDICATION as bankrupt of H. G. W. Cooling, of 10, Market Street, Worksop, a director of Cooling & Lee, Limited, engineers, The White Building, Sheffield, was on February 15 annulled, and the receiving order rescinded.

TRADING UNDER THE STYLE of Wilson Bros., Messrs. J. Wilson and J. Wilson, Parkinson Street, Mill Hill, Blackburn, slaymakers and ironfounders, have dissolved partnership. Mr. James Wilson continues the business in his own name.

TRADING UNDER THE STYLE of Walker, Sandison & Company, Messrs. J. G. Walker and G. A. Sandison, 13, Mosley Street, Newcastle-on-Tyne, engineers and manufacturers' agents, have dissolved partnership. Debts by Mr. J. G. Walker.

TRADING UNDER THE STYLE of H. Woollacott & Company, Messrs. H. Woollacott and C. A. Woollacott, Worsley Gear Works, Worsley Street, Hulme, Manchester, engineers and gear cutters, have dissolved partnership. Debts by Mr. H. Woollacott.

TRADING UNDER THE STYLE of the New Era Machine Company, Messrs. C. Brooks, H. B. Bleasdale, and S. G. Williams, Woodfield Mill, Miller Street, Heywood, and 48, Pennington Road, Bolton, engineers and machine brokers, have dissolved partnership. Debts by Messrs. C. Brooks and S. G. Williams, who continue the business.

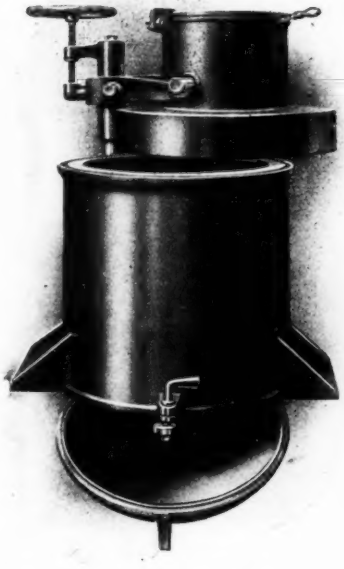
MR. A. E. ALLEN, chairman of W. G. Allen & Sons (Tipton), Limited, Bradley Lane Works, Princes End, Tipton, died recently.

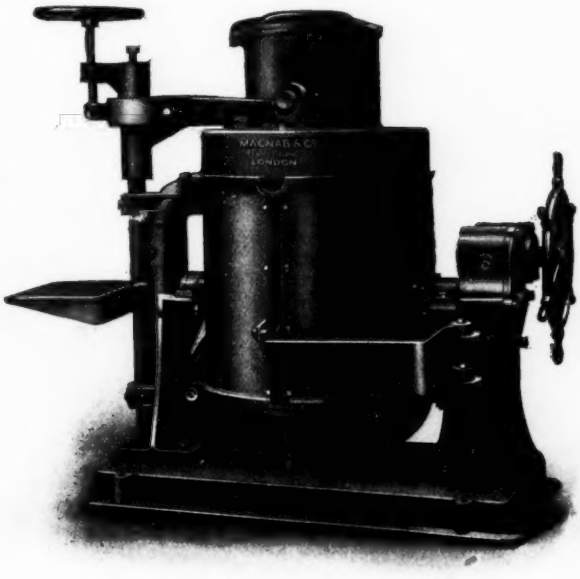
MACNAB & CO.

METAL MELTING CRUCIBLE FURNACE

For Brass, Gunmetal, Aluminium, Iron, etc.

Reduce your fuel cost! **Melt in a hurry!**





Tylor Patent Pit-Type Furnace.

OUTPUT.
200 lbs. Admiralty Gunmetal melted in 35 minutes. Temperature 2000° F.=1093° C.

ECONOMY.
25 lbs. of Coke used per 200 lbs. of Metal melted.

STANDARD CRUCIBLES.
Lasting 35 to 40 heats.

Tylor Patent Tilting-Type Furnace.

OUTPUT.
450 lbs. Admiralty Gunmetal melted in 50 minutes. Temperature 2000° F.=1093° C.

ECONOMY.
80 lbs. of Coke used per 450 lbs. of Metal melted.

STANDARD CRUCIBLES.
Lasting 30 to 40 heats.

56/8, EAGLE STREET, SOUTHAMPTON ROW, LONDON, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	72	12	6
Three months	73	7	6
Electrolytic	80	0	0
Tough	76	10	0
Best selected	76	10	0
Sheets	104	0	0
India	91	10	0
Wire bars	81	10	0
Do. Mar.	81	10	0
Do. Apr.	81	10	0
Ingot bars	81	10	0
H.C. wire rods	85	0	0
Off. aver., cash, Feb.	67	15	3
Do. 3 mths., Feb.	68	9	6
Do. Settlement Feb.	67	15	1½
Do. Electro, Feb.	74	15	4½
Do. B.S., Feb.	72	6	3
Aver. spot price, copper, Feb.	67	14	3
Do. Electro, Feb.	75	0	9

Solid drawn tubes 14½d.
Brazed tubes 14½d.
Wire 11½d.
Yellow metal rods 7½d.
Do. 4x4 Squares 9d.
Do. 4x3 Sheets 10d.

BRASS.

Solid drawn tubes 12¼d.
Brazed tubes 14d.
Rods, drawn 11½d.
Rods, extruded or rolled 7½d.
Sheets to 10 w.g. 10¾d.
Wire 10¾d.
Rolled metal 10½d.

TIN.

	£	s.	d.
Standard cash	211	15	0
Three months	212	15	0
English	212	10	6
Bars	214	10	0
Chinese	211	0	0
Straits	220	0	0
Australian	215	0	0
Eastern	219	5	0
Banca	215	0	0
Off. aver., cash, Feb.	190	12	0¾
Do. 3 mths., Feb.	192	7	5¼
Do. Sttlment, Feb.	190	11	4½
Aver., spot, Feb.	190	10	4½

SPELTER.

	£	s.	d.
Ordinary	36	11	3
Remelted	34	10	0
Hard	29	5	0
Electro 99.9	43	10	0
English	38	0	0
India	31	0	0
Prime Western	38	0	0
Zinc dust	50	0	0
Zinc ashes	14	0	0
Off. aver., Feb.	35	8	9
Aver., spot,			2¼

LEAD.

	£	s.	d.
Soft foreign ppt	29	11	3
English	30	15	0
Off. average, Feb. 28	6		5¼
Average, spot, Feb. 28	10		4½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	44	0	0
Do. V.M. ex whf.	42	0	0
Dutch	42	0	0
Rods	49	0	0
Boiler plates	41	0	0
Battery plates	42	0	0

ANTIMONY.

	£	s.	d.
English regulus	27	10	0
Special brands	33	10	0
Chinese	25	10	0
Crude	20	0	0

QUICKSILVER.

Quicksilver 10 5 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 12 7 6
75% 19 15 0
Ferro-vanadium—
35/40% 17/- lb. va.
Ferro-molybdenum—
70/75% c. free 9/- lb. mo.
Ferro-titanium—
23/25%, carbonless 1/1 lb.
Ferro-phosphorus, 20/23%, £23
Ferro-tungsten—
80/85%, carbon free 1/5 lb.
Tungsten metal powder—
98/99% 1/10½ lb.
Ferro-chrome—
4/6% car. £21 0
6/8% car. £20 0
8/10% car. £19 10
Ferro-chrome—
Max. 2% car. £52 0
Max. 1% car. £62 0
Max. 0.70% car. £72 0
67/70%, carbonless 1/6 lb.
Nickel—99%, cubes or pellets £130 0
Cobalt metal—98/99% 12/- lb.
Aluminium—98/99% £100
Metallic Chromium—
96/98% 4/6 lb.
Ferro-manganese (net)—
76/80%, loose £16
76/80%, packed £17
76/80%, export £16
Metallic manganese—
94/96%, carbonless 2/2 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	4	10	0	5	0	0
Bundled steel & shearings	4	0	0	4	10	0
Mixed iron & steel	4	2	6	4	7	6
Heavy cast iron	4	5	0	4	10	0
Good machinery for foundries	4	5	0	4	10	0
Cleveland—						
Heavy steel				4	7	6
Steel turnings				3	5	0
Cast-iron borings				3	5	0
Heavy forge				5	0	0
Bushelled scrap				4	7	6
Cast-iron scrap				5	0	0
Lancashire—						
Cast-iron scrap				4	15	0
Heavy wrought				4	15	0
Steel turnings				3	5	0

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	63	0	0
Brass (clean)	38	0	0
Lead (less usual draft)	26	0	0
Tea lead	24	0	0
Zinc	25	0	0
New aluminium cuttings	67	0	0
Braziery copper	57	0	0
Gun metal	48	0	0
Hollow pewter	170	0	0
Shaped black pewter	100	0	0

PIG-IRON.

N. E. Coast—
Foundry No. 1 130/-
Foundry No. 3 125/-
Forge No. 4 115/-
Mottled —
Hematite No. 1 121/-
Hematite M/Nos. 120/-
Midlands—
Staffs. common —
,, part-mine forge —
,, ,, foundry —
,, Cold blast, ord. 190/-
,, ,, roll iron 200/-
,, basic —
Northants forge 90/-
,, foundry No. 3 95/-
,, basic 100/-
Derbyshire forge 95/-
,, foundry No. 3 100/-
,, basic 100/-
Scotland—
Foundry No. 1 120/-
,, No. 3 115/-
Hematite M/Nos. 117/6
Sheffield (d/d district)—
Derby forge 98/6
,, foundry No. 3 103/6
Lincs. forge 95/-
,, foundry No. 3 100/-
,, basic 120/-
E.C. hematite 130/3
W.C. hematite 125/-
All d/d in the district.
Lancashire (d/d eq. Man.) —
Derby forge —
,, foundry No. 3 108/6
Northants foundry No. 3 —
Cleveland foundry No. 3 —
Staffs. foundry No. 3 —
Lincs. forge —
,, foundry No. 3 —
Summerlee foundry 132/-
Glengarnock foundry 132/-
Gartsherrie foundry 132/-
Monkland foundry 132/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	£11 0 to 12			10	0	
Angles	£11 0 0 to 12			15	0	
Tees to 3 united ins.	£12 10 0 to 13			0	0	
Nut and bolt	11			10	0	
Hoops	15			0	0	
Marked bars (Staffs.)	13			10	0	
Gas strip	£11/10 to £11/15					
Bolts and nuts, ¾ in. × 4 in.	18			0	0	
Steel—						
Ship plates	10			0	0	
Boiler plates	14			0	0	
Chequer plates	10			15	0	
Angles	£9 10 0 to 10			0	0	
Tees	10			0	0	
Channels	9			15	0	
Joists	9			10	0	
Rounds & squares 3 in. to 5½ in.	11			5	0	
Rounds under 3 in. to ⅜ in.	11			0	0	
Flats, over 5 in. wide and up	11			10	0	
Flats, 5 in. to 1½ in.	10			15	0	
Rails, heavy	9			10	0	
Fishplates	13			10	0	
Hoops (Staffs.)	11			17	6	
Black sheets, 24 g.	13			10	0	
Galv. cor. sheets, 24 g.	£19 5 0 to 19			10	0	
Galv. fencing wire, 8 g. plain	16			0	0	
Rivets, ¾ in. dia.	13			5	0	
Billets, soft	8 0 0 to 9			10	0	
Billets, hard	8 10 0 to 10			5	0	
Sheet bars	8 0 0 to 8			12	6	
Tin bars	8			6	0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 4
Sheet	1 4¾
Wire	1 4¾
Rods	1 3½
Tubes	1 7
Castings	1 2

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4¾ to 1/10½
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6½ to 2/0½
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/- to 1/6
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	29.76
No. 2 foundry, Valley	28.00
No. 2 foundry, Birm.	25.00
Basic	28.46
Bessemer	29.77
Malleable	29.96
Grey forge	29.27
Ferro-manganese 80% delivered	107.50
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	40.00
O.-h. billets	40.00
O.-h. sheet bars	40.00
Wire rods	50.00
	Cents.
Iron bars, Phila.	2.47
Steel bars	2.25
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.25
Skelp, sheared steel	2.25
Steel hoops	2.90
Sheets, black, No. 28	3.50
Sheets, galv., No. 28	4.60
Sheets, blue an'l'd, 9&10	2.65
Wire nails	2.80
Plain wire	2.65
Barbed wire, galv.	3.55
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry 60/- to 65/-
,, furnace 40/- to 45/-
Durham & North. fdy. 42/6
,, furnace 33/3
Other Districts, foundry 42/6
,, furnace 30/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C.Cokes,	20×14, box	22/-
,,	28×20, ,,	44/-
,,	20×10, ,,	32/3
,,	18¾×14, ,,	22/9
C.W.	20×14, ,,	20/3
,,	28×20, ,,	41/-
,,	20×10, ,,	29/-
,,	18¾×14, ,,	20/9
Ternes, f.o.t.	28×20, ,,	40/-

TUBES.

	Up to and incl. 6 in.	
Gas ..	..57½%	Tube prices are now free.
Water	..52½%	
Steam	..47½%	

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

	£ s. d.
Rolled Ordinary—Assortment ..	1/ 0 0 to
Nail Rods—Square, round and flats ..	17 10 0
Keg Steel	nom. £38 to £40
Faggot Steel	nom. £30 to £32
Blooms—Single welded ..	£10 to £11
Billets—Single and double welded	£13 to £14
Pig-iron—Grey, white or mottled	£6 10 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Feb. 28	72	7	6	inc.	7/6
Mar. 1	73	7	6	„	20/–
„ 2	73	15	0	„	7/6
„ 5	73	5	0	dec.	10/–
„ 6	72	12	6	„	12/6

Electrolytic Copper.

Feb. 28	79	10	0	No change	
Mar. 1	80	10	0	inc.	20/–
„ 2	80	10	0	No change	
„ 5	81	0	0	inc.	10/–
„ 6	80	0	0	dec.	20/–

Standard Tin (cash).

Feb. 28	209	5	0	inc.	165/–
Mar. 1	211	10	0	„	45/–
„ 2	208	10	0	dec.	40/–
„ 5	208	17	6	inc.	7/6
„ 6	211	15	0	„	57/6

Tin (English ingots).

Feb. 28	210	0	0	inc.	170/–
Mar. 1	211	0	0	„	20/–
„ 2	209	0	0	dec.	40/–
„ 5	210	0	0	inc.	20/–
„ 6	212	10	0	„	50/–

Zinc Sheets (English).

Feb. 28	44	0	0	No change	
Mar. 1	44	0	0	„	
„ 2	44	0	0	„	
„ 5	44	0	0	„	
„ 6	44	0	0	„	

Spelter (ordinary).

Feb. 28	37	2	6	inc.	2/6
Mar. 1	37	2	6	No change	
„ 2	37	0	0	dec.	2/6
„ 5	36	17	6	„	2/6
„ 6	36	11	3	dec.	6/3

Lead (English).

Feb. 28	30	10	0	No change	
Mar. 1	30	10	0	„	
„ 2	30	10	0	„	
„ 5	30	10	0	„	
„ 6	30	15	0	inc.	5/–

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 11	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 0
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7½
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	85 10	
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	91 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	137 8	
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	209 3	
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
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JAVA STREET, KUALA LUMPUR.
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COX'S BUILDINGS, KARACHI.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

IRON & STEEL SCRAP

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

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ENGINEER, age 39, M.I.Brit.F., 23 years' experience home and abroad, Works, Office Correspondence, Brass and Iron Foundry Practice, General Engineering, Steel and Ironworks Plant, Locomotives and Rolling Stock, etc., desires responsible position Works or Office. —STEPHEN MOSS HOLDEN, c/o 99, Plantation Street, Accrington, Lancashire.

FOUNDRY EXPERT and MANAGER desires position; 20 years' experience; Engineering, Hydraulic, Colliery, Wagon, Textile and General Repetition and Jobbing Castings, Loam, Dry and Greensand, Iron, Semi-Steel, Malleable, and Gun Metal, Hand and Jolt-Rammed and Hydraulic, etc., Moulding Machines. Accept moderate salary for permanency.—Box 380, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY MANAGER, open for re-engagement; has had experience in high-class Grey Iron, Malleable and Gunmetal Foundries, Pattern Shop, Buying Estimating and Sales; has good connection with buyers; Member of Institution of British Foundrymen; also Cast-iron Research; good references from present and previous employers.—Box 376, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

GENERAL COMMERCIAL MANAGER, who is now the Manager of a Trading Company, will, for excellent reasons, shortly be open to accept new appointment. Advertiser is accustomed to organising and carrying through sales propaganda, to appointing and managing agents and travellers, and to general supervision of business.—Write Box 489, c/o STREETS, 8, Serle Street, W.C.2.

LATE PRODUCTION MANAGER of well-known firm desires position; experience in Engine and Ordnance Work, Colliery and General Engineering.—Apply, W. LAING, 4, Main Road, Handsworth, Sheffield.

THE Lancashire Branch of the Institution of British Foundrymen beg to announce that several members, who have had varied experience as Foremen, etc., are at present disengaged. Employers who are in need of Foremen or other members of their foundry staff are invited to communicate with the Honorary Secretary, T. MAKEMSON, 21, Beresford Road, Stretford, Manchester.

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WANTED.—Metallurgist for large Manufacturing Plant in Scotland. Must have had experience in research work and acquainted with modern methods of heat treatment of steel. State qualifications and last employer. Replies will be treated confidentially. —Address, "METAL," Wm. Porteous & Co., Advertising Agents, Glasgow.

WANTED FOR SPAIN.—Assistant Manager for Steel Foundry, light and medium work; good up-to-date practice in Foundry and Electric Furnace imperative.—Particulars of age, education, previous experience, salary required, when free, to Box "SPAIN," Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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INVENTORS Advice, Handbook and Consultations Free. KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Regd. Patent Agent, 146a, Queen Victoria Street, London; 36 years' references.

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WANTED.—ONE TILGHMAN SAND BLAST PLANT, with cleaning chamber 12 ft. x 9 ft. or over; condition, price, where see.—Box 370, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CUPOLA, STAGING, HOIST, FAN.—New, small complete self-contained Plant; melting capacity 35 cwts. per hour, by Constructional Engineering Co., cheap for immediate sale.—Box 374, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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ENGINEERS AND IRONFOUNDERS have for disposal, owing to change of plans, the following Moulding Equipment, in practically new condition:— 1 8 ft. 0 in. x 36 in. Air Receiver, complete with companion fittings and flanges; 1 No. 7 "Ajax" Jarring, Turnover and Pattern Draw Moulding Machine, complete; 1 7 x 6 Class ER-1 Belt-driven Air Compressor, complete.—Full particulars and lowest price on application to Box 378, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

TWO VERTICAL BOILERS, by Ruston, 14 ft. high x 7 ft. diameter, 120 lbs. w.p. 26-H.P. Hornsby Oil Engine, equal to new. 15-H.P. Electric Motor, 460 volts D.C., with Starter. Brand New 4 ft. Under-Driven Sand Mill. Weir Type Boiler Feed Pump, 1,500 gallons per hour, 140 lbs. pressure.

HARRY H. GARDAM & COMPANY, LIMITED, STAINES.

Three Lancashire Boilers, 30 ft. x 8 ft., reinsure 160 lbs. working pressure; new 1916. Two nearly new Steel Lancashire Boilers, 30 ft. x 9 ft., reinsureable at 100 lbs. working steam pressure; complete with steam and furnace fittings, etc. Five Lancashire Boilers, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure. Lancashire Boiler, 28 ft. 0 in. x 8 ft. 0 in. diameter; reinsure 130 lbs. pressure. One Lancashire Boiler, 30 ft. x 8 ft. 6 in., for 100 lbs. pressure. Two Cornish Boilers, 28 ft. x 6 ft. diameter; reinsure 90 lbs. pressure. Several hundreds of Tanks, rectangular and circular, 10 gallons capacity upwards. Several Unused Sectional Steel Cisterns, 8 ft. x 8 ft. x 4 ft. deep, capacity about 1,600 gallons each. A number of High-pressure Receivers, each about 18 ft. 6 in. long x 4 ft. 0 in. diameter by 1⅛ in. thick; 625 lbs. per sq. inch working pressure.

Catalogue of Stock Machinery, 6,000 Lots, Free on application. Inspection invited.

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Excellent 5-ton Geared Ladle, **£40.**
New EVANS 1-ton Ladle, **£18.**
4 New 2½ cwts. Shanks, complete, **£3** each.
10 New 1½ cwts. Shanks, complete, **£2** each.
8 New 1 cwt. Shanks, complete, **30/-** each.
6 New Hand Ladles, complete, **12/6** each.

Two good Second-hand Rumblers, 3 ft. 6 in. x 2 ft. 9 in., **£16** each.
4 ft. Sand Mill, also 4 ft. Loam Mill, **£28** each.
NEW CORE STOVE, 4 ft. x 3 ft. x 3 ft., double-cased, gas-fired, complete, Burners and Thermometer, **£14.**
EVANS' MAGNETIC SEPARATOR, good order, **£18.**

SELECTIONS from boxes in SLOUGH STOCK.

240 pairs, 18 in. x 8 in., cast iron, interchangeable, **8/6** pair.
80 pairs, 12 in. x 12 in., cast iron, interchangeable, **8/6** pair.
14 pairs, 22 in. x 22 in., cast iron, interchangeable, **24/-** pair.
40 pairs, 24 in. x 12 in., cast iron, interchangeable, **18/-** pair.
30 pairs, 20 in. x 10 in., cast iron, interchangeable, **16/-** pair.

ABOUT 2,000 PAIRS OF BOXES ALWAYS IN STOCK.

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